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Factors affecting young driver safety in the state of Louisiana

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FACTORS AFFECTING YOUNG DRIVER SAFETY IN THE STATE OF LOUISIANA

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Dedicated to my dearest pappa and mamma

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ABSTRACT

Though teenage drivers constitute only 6.4 percent of the total drivers in United States, they are responsible for 14 percent of the fatal crashes and are involved in 18 percent of all police-reported crashes in the country. One of the main causes of teenage crashes was found to be the presence of passengers in the vehicle. This study is focused on the effect of passengers on young drivers in the state of Louisiana. There have been efforts from traffic safety departments to contain crashes involving this age group of drivers and, particularly the Graduated Driver's License Law, which imposes restrictions on driving conditions of young drivers, was introduced in almost every state in the country to address this issue. This study analyses the crash database obtained from the Louisiana Department of Transportation (LaDOTD) from years 1999 to 2004 using the quasi-induced exposure technique. This technique is used to disaggregate crashes by different characteristics or circumstances and to make estimates of the relative travel exposure for these different characteristics. Relationships are developed to investigate the effect of passengers on young drivers' (age 15 to 21) crash propensity. Three passenger groups were used; solo (no passenger), peer, and adult or child. Different variables were considered for possible interaction with passenger group: driver gender, occupant gender, time of week, time of day, and safety-restraint usage. It was found from this study that young drivers were involved in fewer crashes when they travel with adults and/or with children and have an increased propensity to being involved in single-vehicle crashes when they are traveling with their peers. It was also found that they are highly prone to crashes when they drive at night and when the number of peer passengers increase in the vehicle. All these results point to restructuring the existing Graduated Driver's License Law in Louisiana to contain crashes involving teenage drivers.

1. INTRODUCTION

1.1 Background

Motor vehicle crashes are the leading cause of death among American teenagers, killing between 5,000 and 6,000 every year for the past decade (National Highway Traffic Safety Administration, 2003). From 1994 to 2003, a total of 57,142 teenagers were killed in motor vehicle crashes in the United States. Teenage drivers constitute 6.4 percent (12.5 million) of the total drivers in the United States, but account for 14 percent of all drivers involved in fatal crashes and 18 percent involved in all police-reported crashes. No other hazard comes close to claiming as many teenage lives, including teenage homicides (14 percent) of all teenage fatalities and suicides (11 percent) of all teenage fatalities (Insurance Institute for Highway Safety, 2005). Motor vehicles crashes account for approximately one third of all teenage fatalities.

According to a report on teenage driving by Allstate Insurance Company (2007), the primary cause of teenage motor vehicle crashes are the excessive speed and other driver errors like running off the road, driving in the wrong lane, driving under the influence of alcohol, drugs, or medication and erratic or reckless driving. Further in the report, it states that crash risk is particularly high during the first years that teenagers are eligible to drive. It has also been suggested that the increase in the crashes among the young drivers is due to the tendency of young people to take risks, drive fast and peer pressure (Insurance Institute for Highway Safety, 2005).

Passengers have a great effect on the drivers, especially on young drivers. In a study conducted by Wells and Williams (1995) focusing on deaths of teenage passengers in motor vehicles, it was noted that young drivers are much more likely to cause crashes when other teenagers are in the car, and the risk of a fatal crash increases in proportion to the number of

teenage passengers. The age and the gender of the passenger also matters when a young driver is behind the wheel. There have been various studies done which shows that the presence of male passengers increases the chances of having a crash over having female passengers. According to the reports by Social Issues Research Centre (SIRC, 2004), when a male passenger is in a vehicle one-fourth of teenage drivers exceed the speed limit by at least 15 miles per hour.

From past research, it seems clear that there should be restrictions made on the teenage drivers. They are too immature and inexperienced to handle the high speed and the split second decisions they need to make on roads. They should be held responsible for not only their own life but the lives of passengers and the other people who use the road. They should be given proper training before they take the vehicle on the roads by themselves and the parents should make sure that they induce some kind of responsibility within the younger people as they grow up. The reaction time of a driver can be improved by driving more, and with an experienced driver by the side, a young driver can attain very valuable lessons on what to do in different scenarios.

1.2 Problem Statement

Though some restrictions were imposed on young drivers by the introduction of Graduated Driver's License Law in Louisiana in 1998, young drivers have higher crash risks than adult drivers with and without passengers according to the Louisiana traffic data. With the presence of passengers, 15-21 years old drivers have higher crash risks than 21-25 year old drivers and older drivers. Crash risk increases as the number of passengers increase. Key areas of driving that need to be addressed must be identified so as to make the lives of younger generations safer.

2. LITERATURE REVIEW

A review on the crashes by young drivers and its impact on safety, effects of passengers on young drivers, studies on the Quasi-induced Exposure technique and an overview of current Graduated Driver's License Law and the various restrictions in Louisiana and other states are presented below.

2.1 Studies on Crashes by Young Drivers

Agran et al. (2001) states that transportation crashes are the number one cause of injury/death for people between 15 and 19 years of age. From the studies by Mayhew et al. (2003), it was found that as a group, young drivers have crash rates that far exceed those of older, experienced drivers. But even among teenagers there are age-related differences; crash rates decline consistently and dramatically with each yearly increase in age. It was found that crash rates drop most dramatically during the first 6 months of driving (Figure 2.1, novice drivers are those who just got a full license to drive on their own and the learners are those for whom supervised driving is required). Involvement in certain types of crashes—e.g. run-off-the-road, single-vehicle, night, weekend—declines more rapidly. Doherty et al. (1998) states that the crash involvement rate of 16-19 year old drivers are higher than those of 20-24 years old and even higher relative to 25-59 year olds in all situations examined.

A study was conducted by Foss et al. (2001) to determine the initial effect of the North Carolina Graduated Driver's License (GDL) system on crashes among 16-year-old drivers. Crash rates declined sharply for all levels of severity among 16-year-old drivers after the Graduated Driver's License program was implemented. Comparing data from year 1996 with 1999, fatal crashes declined 57%, from approximately 5 to 2 crashes per 10,000 population; crashes with minor or no injuries decreased 23%, from 1068 to 826 crashes per 10,000 population. Night time

crashes were 43% less likely (156 vs. 88 crashes per 10,000) and daytime crashes decreased by 20% (951 vs. 764 crashes per 10,000). Single-vehicle crashes (245 vs. 175) declined somewhat more than multiple-vehicle crashes (866 vs. 681).

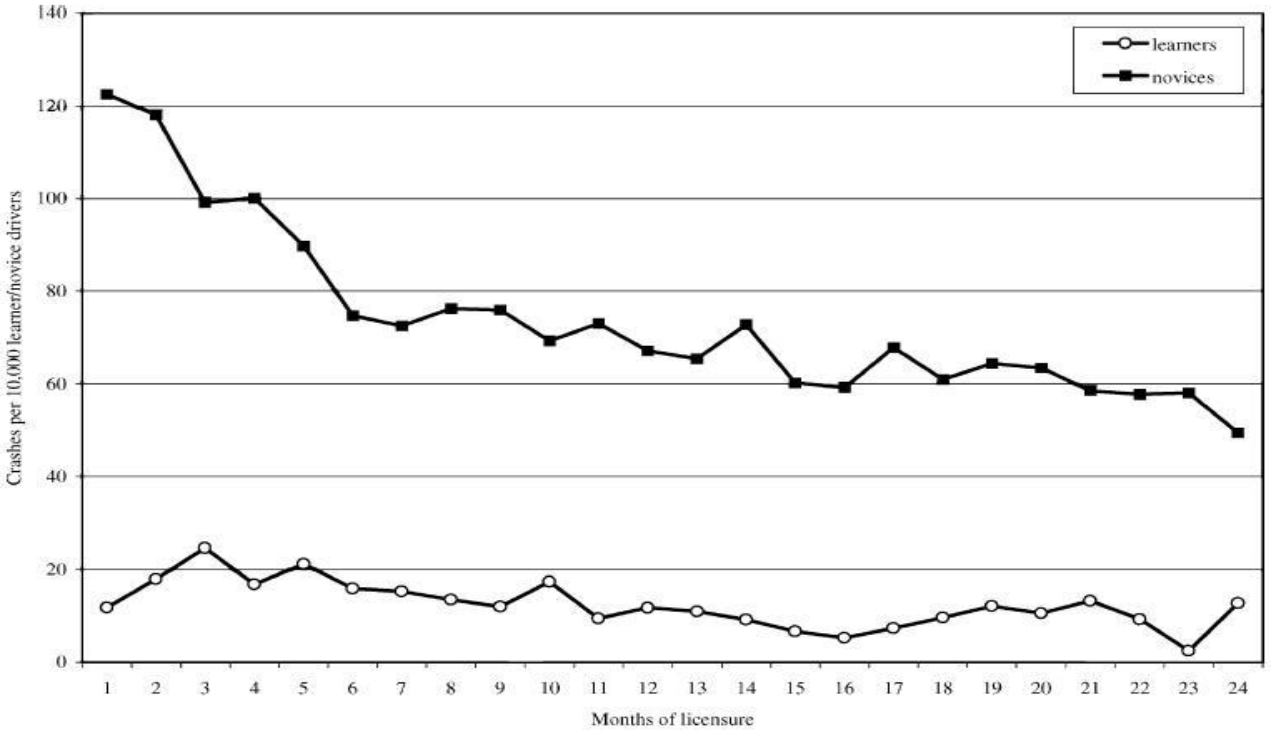

Figure 2.1: Crash rates by license status and months of licensure (Mayhew et al. 2003)

2.2 Studies on the Effect of Passengers on Young Drivers

In the studies done by Preusser et al (1998), it is stated that the young drivers have a higher propensity of having crashes at night time with passengers accompanying them. Doherty et al (1998) has clearly stated that the crash involvement rates of 16-19 year old drivers are higher with passengers than without, regardless of crash severity and regardless of whether it was daytime or night time, weekday or weekend and he also stated that the negative effect of passengers on overall crash rates was evident only for the 16-19 year old driver group.

Williams (2001) did a study for the Insurance Institute for Highway Safety on crashes when there is a teenage passenger with the driver. It used Fatal Accident Reporting System

(FARS) 2000 data for the study. According to FARS, almost 45% of the people killed in the age group 13-19 are passengers, and 63% of deaths of 13-19 year olds passengers occurred when other teenagers were driving.

2.3 Studies on the Quasi-Induced Exposure Technique

Crash statistics are often reported in terms of the number of crashes per 100 million vehicle kilometers traveled to account for the exposure motorists experience. Vehicle-kilometers traveled are estimated by simply multiplying the average daily traffic of the roadway by the length of the roadway. However, this estimate of vehicle-kilometers traveled is for all travel and does not allow for distinction among drivers, occupants, vehicles, time of day, day of week or any other division of the traveling public. To overcome this limitation, exposure methods like "induced exposure" have been developed that derive exposure estimates from the crash database itself (Stamatiadis and Deacon, 1997). The concept of induced exposure is traced back to Thorpe (1967). He developed formulas that determined the relative likelihood of driver involvement in a crash as the ratio of the number of involvements to exposure. Involvements are expressed as the percentage of crashes that occur in a given class. The exposure to a crash for a given class *i* of drivers is computed from the formula $2T_i - S_i$, where T_i is the percentage of all crashes that involve multiple vehicle crashes for drivers in class *i*, and S_i is the percentage of single vehicle crashes for the same group of drivers. When the percentage of multiple vehicle crashes increase, the exposure to a crash is thereby assumed to increase but it is modified by the percentage of single-vehicle crashes. This is consistent with the notion that the percentage of crashes in a category is a measure of the exposure, or activity, in that category, but that it needs to be modified by a measure of the crash propensity in that category as measured by the percentage of single-vehicle crashes.

The next step in the use of induced exposure was taken by Carr (1970) who introduced the notion of being able to identify the driver responsible for the occurrence of a multiple vehicle crash based on the investigating police officer's report. Haight (1970) called this approach quasi-induced exposure. Both Thorpe and Carr measured the relative involvement to exposure ratio using as the numerator the percentage of crashes for a given driver/vehicle group and as the denominator, the exposure as calculated by their models. In Thorpe's case, exposure is the calculated difference of the percentage of multiple- and single-vehicle crashes, as described earlier. In Carr's case, it is the percentage of non-responsible drivers in multi-vehicle crashes for the corresponding driver/vehicle groups. Quasi-induced exposure, as developed by Carr, has been used more frequently than any other induced exposure formulation.

Stamatiadis and Deacon (1997) suggested that the induced exposure technique yields estimates of relative exposure for the subsets of driver and/or vehicle populations of interest. More specifically the quasi-induced exposure technique derives these estimates from the distribution of non-responsible drivers/vehicles in the set of two-vehicle collisions for which fault can be reasonably attributed to one and only one driver/vehicle. The key assumption is that the distribution of non-responsible drivers/vehicles closely mirrors the distribution of all drivers/vehicles exposed to crash hazards, and, therefore is a suitable measure of exposure of driver/vehicle subsets. The method has been successfully used for disaggregate crash safety analysis for older drivers (Stamatiadis and Deacon, 1995), road characteristics (Stamatiadis et al., 1999), passenger effects on older drivers (Hing et al., 2003), and young drivers (Aldridge et al., 1999). Preusser et al. (1998) also applied the quasi-induced exposure method to study the effect of teenage passengers on the fatal crash risk of teenage drivers.

The quasi-induced exposure technique is further explained in the methodology.

2.4 A Review of the Graduated Driver's Licensing Law

Graduated Driver Licensing (GDL) has been proposed as a means of reducing crash rates among novice drivers by gradually introducing them to higher risk driving situations. The Graduated Driver's License law in Louisiana provides for three phases of licensing for persons less than 18 years of age:

- Phase I-Learner's License: In order to obtain a learner's license, a person must be at least 15 years old, must complete an approved driver education course approved by the Department of Education or the Department of Public Safety and Corrections consisting of a minimum of thirty hours classroom training and six hours of on-the-road training, have the consent of a parent or guardian, and pass a written and visual test. People with a learner's license cannot drive unless accompanied by a licensed driver. There is a mandatory holding period of 3 months for the learner's license. There is no minimum amount of supervised driving required by law.
- Phase II-Intermediate License: An intermediate driver license can be obtained after reaching the age of 16, holding a learner's license for at least 6 months and passing a driving test. Drivers with intermediate licenses may not drive unsupervised between 11 p.m. and 5 a.m. There is no passenger restriction for the intermediate licensed drivers
- Phase III-Full License: Graduated Driver's License restrictions end at the age of 17. Crashes or violations may delay the process.

By 1999, Graduated Driver's Licensing laws had been passed in 23 states. The restrictions imposed by the law are not uniform across states as can be seen in the Table 2.1

(National Highway Traffic Safety Administration, 2007). However, there is a commonality of factors included in the Graduated Driver's License, although not all states consider all factors.

The Louisiana Department of Transportation and Development (LaDOTD) has identified seven peer states for transportation comparison across a wide array of measures, including safety, pavement condition, congestion, budget, etc. These official peer states are Alabama, Arkansas, Colorado, Kentucky, Mississippi, Oklahoma, and Tennessee. So for comparison of the change in the Graduated Driver's License program, the state of Kentucky is considered. Kentucky and Louisiana had similar Graduated Driver's License laws when they were introduced in 1995 and 1998 respectively, but later Kentucky improved their program to 60 hours of supervised driving which includes 10 hours of night driving during learning phase and a passenger restriction during the intermediate phase. (The supervised driving mentioned here means there should be an accompanying licensed driver who is a parent or guardian to the driver or driving instructor). But no changes have been brought in the Graduated Driver's Licensing program in Louisiana for supervised driving and passenger restrictions. In Louisiana, after getting the learner's license there is a holding period of at least 3 months. During this time, young drivers can only drive under the supervision of a licensed driver but the state of Louisiana does not require a minimum amount of supervised driving hours as required by most other states. The existing license system of all the states is listed in Appendix A.

According to a research conducted on the change in crash rate in Louisiana before and after the introduction of Graduated Driver's License Law in Louisiana, Mudumba (2008) found GDL to be effective in decreasing the motor vehicle injury, PDO and all crash rates among 15 and 16 year-old drivers in Louisiana.

Table 2.1: Graduated Driver's License Law in Individual States (NHTSA,2007)

state	Minimum Entry Age	Mandatory Holding Period (months)	Minimum Amount of Supervised Driving	Minimum Age	Duration of Nighttime Restriction (months)	Unsupervised Driving Prohibited	Passenger Restriction	Minimum Age Unrestricted License
California (eff. 7/1/98)	15	6 mo.	50 Hr., 10 of which must be at night	16	12 mo.	Midnight to 5 a.m.	First 6 mo.: No passengers younger than age 20	17
Connecticut (eff. 1/1/97)	16	6 mo	None		16, 6 mo			
Delaware (eff. 7/1/99))	15, 10 mo.	6 mo	None	16	6 mo.	9 p.m. to 6 a.m	No more than 2 passengers	16 and10 mo.
Florida (eff. 7/1/96)	15	6 mo.	None	16	Until age 18	11 p.m.to6 a.m. (age 16); 1 a.m. to 5 a.m. (age 17)	None	18
Georgia (eff. 1/1/98)	15	12 mo.	None	16	Until age 18	1 a.m. to 5 a.m.	No more than 3 passengers younger than age 21	18
Georgia (eff. 1/1/98)	15	12 mo.	None	16	Until age 18	1 a.m. to 5 a.m.	No more than 3 passengers younger than age 21	18

Table 2.1 (continued…)

state	Minimum Entry Age	Mandatory Holding Period (months)	Minimum Amount of Supervised Driving	Minimum Age	Duration of Nighttime Restriction (months)	Unsupervised Driving Prohibited	Passenger Restriction	Minimum Age Unrestricted License
Illinois (eff. 1/1/98)	15	3 mo.	25 hr.	16	Until age 17	11 p.m. to 6 a.m. Sun-Th; Midnight to 6 a.m. F-Sat	Until age 18: No more than one passenger in front and no more passengers in the rear than there are available belts	17
Indiana (eff. 1/1/98)	15	2 mo.	None	16 and 1 mo.	Until age 18	1 a.m. to 5 a.m. Sat-Sun; after 11 p.m. Sun-Th	First 90 days: No passengers unless supervised by 21-year old driver	18
Iowa (eff. 1/1/99)	14	6 mo.	20 hr., 2 of which2 must be at night	16	12 mo.	12:30 a.m. to 5 a.m.	None	17
Kentucky (eff. 10/1/95)	16	6 mo.	None		16, 6 mo.			
Louisiana (eff 1/1/1998)	15	3 mo.	none	16	until age 17	11pm to 5 am	None	17
Maine (eff. 8/1/98)	15	3 mo.	35 hr., 5 of which must be at night		16			
Maryland (eff. 7/1/98	15 and 9 mo.	4 mo.	40 hr.	16 and 1 mo.	18 mo.3	Midnight to 5 a.m.	None	17 and 7 mo.
Massachusetts (eff. 11/4/98)	16	6 mo.	12 hr.	16 and 6 mo.	Until age 18	Midnight to 5 a.m.	First 6 mo.: No passengers younger than age 18 unless supervised by 21-year old driver	18

Table 2.1 (continued…)

state	Minimum Entry Age	Mandatory Holding Period (months)	Minimum Amount of Supervised Driving	Minimum Age	Duration of Nighttime Restriction (months)	Unsupervised Driving Prohibited	Passenger Restriction	Minimum Age Unrestricted License
Michigan (eff. 4/1/97)	14, 9 mo.	6 mo.	50 hr., 10 of which must be at night	16	6 mo.	Midnight 5 a.m.	None	17
Minnesota11 (eff. 1/1/99)	15	6 mo.	30 hr., 10 of which must be at night		17			
Nebraska (eff. 1/1/99)	15		50 hr.	16	12 mo.	Midnight 6 a.m.	None	17
New Hampshire (eff. 1/1/98)	16	3 mo.	None	16, 3 mo.	Until age 18	1 a.m. 5 a.m.4	None	18
New Jersey	16	6 mo.	None	17	12 mo.	Midnight 5 a.m.	Limit one passenger	18
North Carolina (eff. 12/1/97)	15	12 mo.	None	16	6 mo.	9 p.m. 5 a.m.6	None	16, 6 mo.
Ohio (eff. 1/1/99)	15, 6 mo.	6 mo.	50 hr., 10 of which must be at night	16	Until age 17	1 a.m. 5 a.m.	None	17
Rhode Island (eff. 1/1/99)	16	6 mo.	None	16, 6 mo.	12 mo.	1 a.m. 5 a.m.	None	17, 6 mo.
South Carolina (eff. 7/1/98)	15	3 mo.	None	15, 3 mo.	12 mo.	6 p.m. 6 a.m.		16, 3 mo.
South Dakota (eff. 1/1/99)	14	6 mo. (3 mo. with driver education)	None	14, 6 mo.	Until age 16	8 p.m. 6 a.m.	None	16
Virginia (eff. 7/1/98)	15	6 mo.	None		16			

3. OBJECTIVES

The main objective of the research was to determine the various factors affecting young driver safety from the police-reported crash database in the state of Louisiana. This was achieved by analyzing the safety record of young drivers in Louisiana for a time period of six years from 1999 to 2004. The database was disaggregated by different characteristics like age and sex of the drivers and passengers, the time of the day when the crash occurred, the usage of passenger restraint and other factors.

4. METHODOLOGY

4.1 Introduction

The Louisiana crash statistics were studied to analyze the crashes involving young drivers. The crash causing tendency of young drivers was studied using the quasi-induced exposure methodology. The crash causing tendency of groups of young drivers was measured using the Relative Crash Involvement Ratio (RCIR), as defined in the next section.

4.2 The Quasi-Induced Exposure Technique

Traditional measures of road safety relate the number of crashes to the total number of vehicle miles traveled (VMT). As an overall measure this is fine because VMT can be estimated simply by multiplying the traffic volume by the length of the roadway. However if statistics are required for subsets of the population, it is not possible to estimate VMT for them. The quasi-induced exposure method allows for disaggregate analysis by using the crash database itself to generate a relative exposure measure from the drivers who are not-at-fault in two vehicle crashes. The exposure mentioned here refers to any measure of the relative amount of travel undertaken by young drivers in different circumstances, for example night versus day driving, or driver, passenger and vehicle characteristics.

For the purpose of the analysis, the young drivers considered are between the ages of 16 and 20. Individuals between the ages of 12 and 24 are considered as peers to a young driver and therefore, all passengers of this group in a vehicle driven by a 15-21 year old will be classified as "peer". If there is a person above the age of 24 (i.e. an adult) or a person below the age of 12 (i.e. a child) present in the vehicle with the young driver, it is assumed that his or her behavior will adjust accordingly due to the presence of supervision or an added sense of responsibility in the

presence of a child and this group will be classified as “adult/child passengers”. The third passenger category will be termed “solo”, and refers to the case when the young driver is alone.

The Relative Crash Involvement Ratio (RCIR) calculation procedure requires that only single and two vehicle crashes can be used (93.3 percent of total crashes in the state of Louisiana in the study period of six years are single and two vehicle crashes). The assumption made will be that the distribution of the not-at-fault drivers will be representative of the travel exposure of all drivers in that group. A fundamental requirement of the quasi-induced exposure technique is the determination of the at-fault driver who is mainly responsible for the crash occurrence. The fault assignment relies heavily on the judgment of the police officer at the scene of crash. The drivers with violation code entered as “U’ in the data sheet is considered as not at-fault while the rest are considered as at-fault drivers. The assumption is that for every multivehicle crash there can only be one driver of the two can be at-fault and the drivers in the single vehicle crashes can either be at-fault or not depending on the judgment of the reporting policeman. The RCIR is calculated by taking the ratio of the percentage of at-fault drivers in a specific subgroup to the percentage of the not-at-fault drivers from the same subgroup.

The crash ratio will be derived for both single-vehicle ($RCIR_s$) and two-vehicle ($RCIR_m$) crashes. The denominator in both is the percentage of not-at-fault drivers in two-vehicle crashes, and the numerator is the corresponding percentage of at-fault drivers. Ratio values greater than 1.0 indicates the specific subgroup of drivers is more likely to cause a crash. In a similar way, a ratio of less than 1.0 indicates that the drivers in the specific subcategory are less crash prone. The issue of assigning fault in a crash is determined based on the information contained in the crash database.

A hypothetical calculation is shown in Eq. (1). In this case, the ratio computed is that of young male drivers. The numerator indicates that 12,000 crashes out of 16,000 were male drivers at-fault in single vehicle crashes. The denominator indicates that in a total of 20,000 two-vehicle crashes involving not-at-fault young drivers, there were 10,000 crashes involving young male drivers. This percentage is taken to be a measure of the relative travel exposure. Therefore, in this case, the interpretation would be that younger males and females drive the same amount. Given this assumption, the RCIR value indicates that the young men are 1.5 times as likely to be involved in a crash compared to the female drivers.

$$RCIR_s = \frac{\%\text{ young male drivers at-fault in single-vehicle crashes}}{\%\text{ young male drivers not-at-fault in two-vehicle crashes}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$= \frac{12,000/16,000}{10,000/20,000}$$

$$= 0.75/0.5$$

$$= 1.5$$

4.3 Data Source

The database used for the analysis consists of detailed information on crashes that occurred throughout the state of Louisiana for the years 1999 to 2004 obtained from the Louisiana Department of Transportation and Development (LADOTD).The crash database consists of over 100 data items for about 150,000 crash records every year. The database was created and corrected by eliminating errors and missing data by the Information System and Decision Science (ISDS) Department of Louisiana State University for the Louisiana Department of Public Safety and Correction using the Uniform Motor Vehicle Crash Reports maintained by the Louisiana State Police. The database contains details of each crash such as

crash number, crash severity, location of crash, crash contributing factors, time and day of crash, details of vehicles involved in crash, the driver and passenger details like age and sex, roadway characteristics at location of crash such as posted speed limit, road alignment, surface type and condition, lighting and weather conditions, type of collision, and other crash details.

The crash data for Louisiana for 1999 to 2004 consists of various separate tables as follows:

1. Crash table (CRASH_TB) – consists of the crash details such as the date and time of the crash, number of vehicles involved in the crash and so on
2. Vehicle table (VEHIC_TB) – consists of the vehicle details like the type and make of the vehicle and driver details like the age and sex of the driver, condition of the driver at the time of crash and so on
3. Occupancy table (OCCUP_TB) – consists of the occupant details like the age and sex of the occupant, number of occupants in the vehicle and so on
4. Pedestrian table (PEDES_TB) – consists of the pedestrian details
5. Train table (TRAIN_TB) – consists of the details of the vehicular crash involving a train
6. Train occupancy table (TROCC_TB) – consists of the details of the occupants of the vehicle involved in the crash with the train

The crashes mentioned in the analysis can be fatal crashes, injury only crashes and property damage only (PDO) crashes caused either by single-vehicle or two-vehicle crashes. The crash table, vehicle table and occupancy table were only used for this study and the sorting and combining of these tables are mentioned in following section.

4.4 Sorting the Data

As mentioned in section 4.3, the data consists of six tables with almost 150,000 entries for 100 data fields each corresponding to years from 1999 to 2003. The tables were combined into one dataset to save time on querying for each individual year. The crash identification numbers in each table was the primary key which is unique for each crash. The primary key was used to join the data files into a single database. A new database with the name "COMBINED_TB" was created by including all the variables necessary for the analysis.

The assumption made for the quasi-induced exposure technique is that only one of the drivers involved in two vehicle crashes is considered to be at-fault. So the driver at-fault has to be identified. This was done by reviewing the citation data provided by the reporting police officer, depending on whom he considered to be at-fault of the crash. The data field "VIOLATIONS_CD" in the table "VEHIC_TB" recorded this data. The entries corresponding to entry "U" meant that the driver was not at fault in the crash according to the police officer who was present at the crash site and was taken as not at-fault drivers. The drivers with any other entry were considered as at-fault drivers. These data were tabulated as separate tables and were named "violation" and "noviolation". Further sorting mentioned below was done for both these tables.

The quasi-induced exposure technique uses only single vehicle and two vehicle crashes for the calculation of RCIR and thus the data containing these types of crashes was filtered out of the entire database and the rest discarded. For that, the data field used is the NUM_VEH in the crash table. The entry is an integer which corresponds to the number of vehicle involved in the crash. This was queried out from the above tables into new tables.

Only data for young drivers within the age group of 15 to 21 was used and the rest was discarded. Passenger groups were established and classified as peer group, solo and child/adult. The peer group consisted of passengers within the age of 12 to 24, every passenger being in that age group. If the passenger group included at least one adult (i.e. above the age of 24) or a child (i.e. below the age of 12) then the group was considered a child/adult group. If the driver was alone in the car at the time of crash then it was considered to be in the solo group.

Various categories which were sorted from the database are:

a) Passenger gender and number of passengers present.

   Passenger gender was investigated to determine whether drivers behave differently with occupants of the same gender versus a mixed group. The crashes were divided into three subcategories based on the gender of the passengers and drivers: all male, all female and mixed (drivers who are alone are not included). The number of passengers was also examined for possible crash causing interaction of young drivers with different passenger groups.

b) Weekday or weekend

   In order to investigate if the young drivers behave differently based on occupant categories on weekends versus weekdays, assumptions were made as to the definition of a weekend. The weekends were assumed to include Friday, Saturday and Sunday as these days were considered as the days of maximum social activities.

c) Time of the day.

   Differences in the effect of passenger category by time of day also might exist due to either trip purpose or the skill required for driving in darkness. The 24hrs was divided into 11 pm to 5 am (as that is the restriction in the existing Graduated Driver's

License program in Louisiana), 5 am to 10 am, 10 am to 3 pm, 3 pm to 7 pm and 8 pm to 11 pm.

d) Use of safety restraints

In an effort to suggest some sort of relation between young drivers' motivations and the willingness to take risks based on the passenger group present, the usage of safety restraints devices among the drivers was checked.

4.5 Data Analysis

The data analysis for this study was conducted in two phases. First, the count of crashes for each of the variables mentioned above was taken using MS Access by SQL queries and according to the requirements of each category. For example, the number of crashes of male drivers with male passengers was done by first taking the crash numbers of the crashes with male passengers, out of which the crashes which also had female passengers along with the male passengers were deleted. Then intersection of the crashes with male drivers only with this table gives the male driver-passenger mix.

The second part of the analysis involves the calculation of the RCIR values for each category. The Relative Crash Involvement Ratio (RCIR) is calculated by taking the ratio of the percentage of at-fault drivers in a single- or two-vehicle crash in a specific subgroup to the percentage of not-at-fault drivers in multi-vehicle crashes from the same subgroup. The calculation was done using MS Excel. A sample calculation is shown in Eq. (2). In this case, the ratio computed is that of young male drivers. From the table in Appendix B, the number of young male drivers at-fault in single vehicle crashes when traveling alone is 18,579 and the total number of single-vehicle crashes involving young drivers is 33,772(i.e. the sum of all at-fault single vehicle crashes involving young drivers, 26708+5548+1516). This means that 55.01% of

the single vehicle crashes in the state of Louisiana involve male drivers aged 15 to 21 traveling alone. So the numerator is that 55.01% of the at-fault young drivers in single vehicle crashes are male. The denominator indicates the percentage of young male drivers when they drove alone in a not-at-fault vehicle in a two-vehicle crash. The total number of two-vehicle crashes involving young drivers when they were not-at-fault of the crash is 94,803(i.e. the sum of all not-at-fault two-vehicle crashes involving young drivers, 75382+12960+6461) and of which 38,314 was driven by young male drivers traveling alone. Thus, that percentage for the denominator is calculated to be 40.41%.

$$RCIR_s = \frac{\%\text{ young male drivers at-fault in single-vehicle crashes when they travel alone}}{\%\text{ young male drivers not-at-fault in two-vehicle crashes when they travel alone}} \quad \ldots\ldots\ldots (2)$$

$$= \frac{18{,}579/33{,}772}{38{,}314/94{,}803}$$

$$= 55.01/40.41$$

$$= 1.36$$

Therefore, the RCIR value for single vehicle crash of young male drivers when they are travelling alone is 1.36. The RCIR values for single-vehicle and two-vehicle crashes were tabulated as tables in Appendix C.

4.6 Interpreting the Results

Relative Crash Involvement Ratio (RCIR) values greater than 1.0 indicates the specific subgroup of drivers is more likely to be involved in a crash. In a similar way, a ratio of less than 1.0 indicates that the drivers in the specific subcategory are less crash prone.

4.7 Substitution Method for Estimation of Confidence Intervals

A confidence interval is a range of likely values for an unknown population parameter at a given confidence level. The limits of this range are called the confidence limits. The most common method of calculating the confidence limits involves the normal approximation, in which a multiple of the standard error (SE) is added to and subtracted from the sample value for the measure. For 95% confidence limits, the general expression is

$$\text{Statistic} \pm 1.96\ \text{SE (statistic)} \quad \ldots\ldots\ldots\

The substitution method is further explained by a sample calculation for the confidence interval estimation for single-vehicle crashes involving male drivers driving alone. The crashes were tabulated as follows:

Table 4.1 Number of crashes for male drivers for single vehicle crashes

	solo only	Rest of the crashes	Total
number of crashes for male drivers at-fault	18,579 *a*	15,193 *b*	33,772 *a+b*
number of crashes for male drivers not at-fault	38,314 *c*	56,489 *d*	94,803 *c+d*
total	56,893	71,682	128,575

Therefore, the SE ($\log_e$ RCIR) value is $\sqrt{\frac{1}{18,579}-\frac{1}{33,772}+\frac{1}{38,314}-\frac{1}{94,803}}$ which was calculated to be 0.006306 and $\log_e$ RCIR was found to be 0.31. So the upper and lower values were calculated from eq. (4) as 0.32075 and 0.29603. The exponential of these values gives the limit for $RCIR_s$ of the category and the limits are 1.378 and 1.344. Hence, it can be inferred with 95% confidence that the $RCIR_s$ value was between 1.344 and 1.378.

5. RESULTS AND DISCUSSIONS

The RCIR values for single-vehicle and two-vehicle crashes were calculated separately for all three passenger groups and each passenger group was further divided into three driver groups according to the age. The lower and upper limits for 95% confidence interval are also given along the calculated RCIR values in Appendix C. The table containing the number of crashes for each group is listed as Appendix B. Graphical representations of each category are shown. In the graphs, the whisker in the bars represents the range for a 95% confidence interval.

5.1 According to Various Passenger Groups

From Figures 5.1.1 and 5.1.2, it is clearly evident that young drivers with learner's license (i.e. drivers younger than 16 years) are most likely to be involved in crashes when traveling with their peer group and they are safest when traveling with an adult or a child for both single-vehicle and two-vehicle crashes. This suggests that adult supervision has a strong influence on young drivers to drive safely. When they are traveling with peers, the chance of being involved in a single-vehicle crash is greater than the chance of being in a two-vehicle crash, with an RCIR value of 2.93 versus 1.60 for two-vehicle crashes. Single vehicle crashes are mostly caused by distractions during driving and the risk taking nature of the driver. The higher value of single vehicle RCIR here suggests that there are distractions to the young drivers caused by the peer group or peer pressure contributing to risk taking. Adding to this observation is the fact that the highest RCIR values in each group in the analysis is for the drivers below the age of 16 (i.e. the drivers with learner's permit) involved in single-vehicle crashes with the peer group along with them. Moreover, the adult/child category has the lowest RCIR values of the three passenger groups, suggesting that the driver attitude does indeed change when there is an adult supervision or they have responsibility for a younger child in the vehicle. The RCIR values for single drivers for all age groups are approximately 1 for both single-vehicle and two-vehicle

crashes, suggesting that the young drivers are relatively responsible when alone and do not tend to take the risk that they do when they are with their peers.

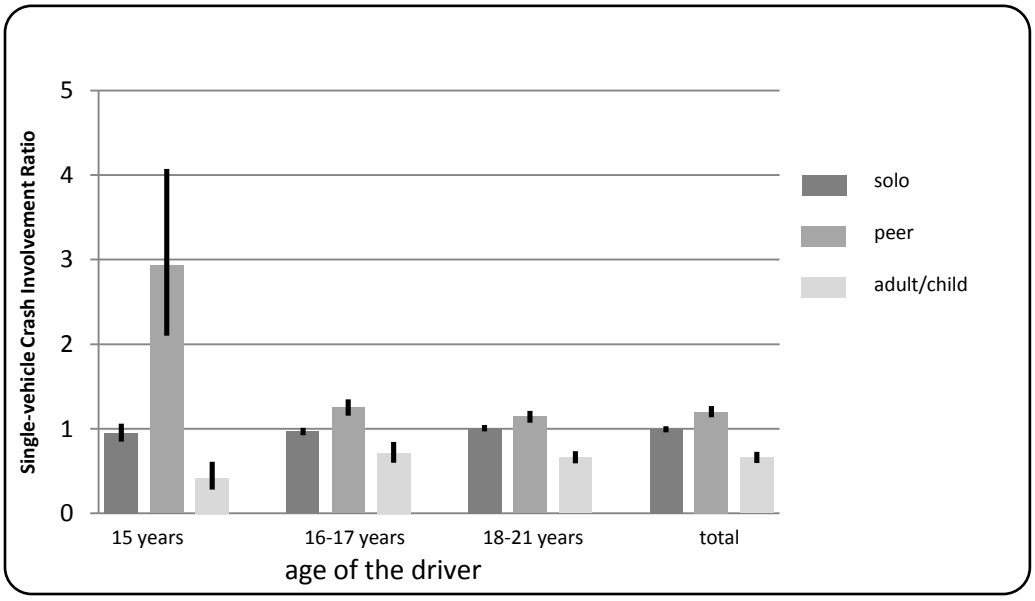

Figure 5.1.1: Single-vehicle Crash Involvement Ratio for Different Passenger Groups

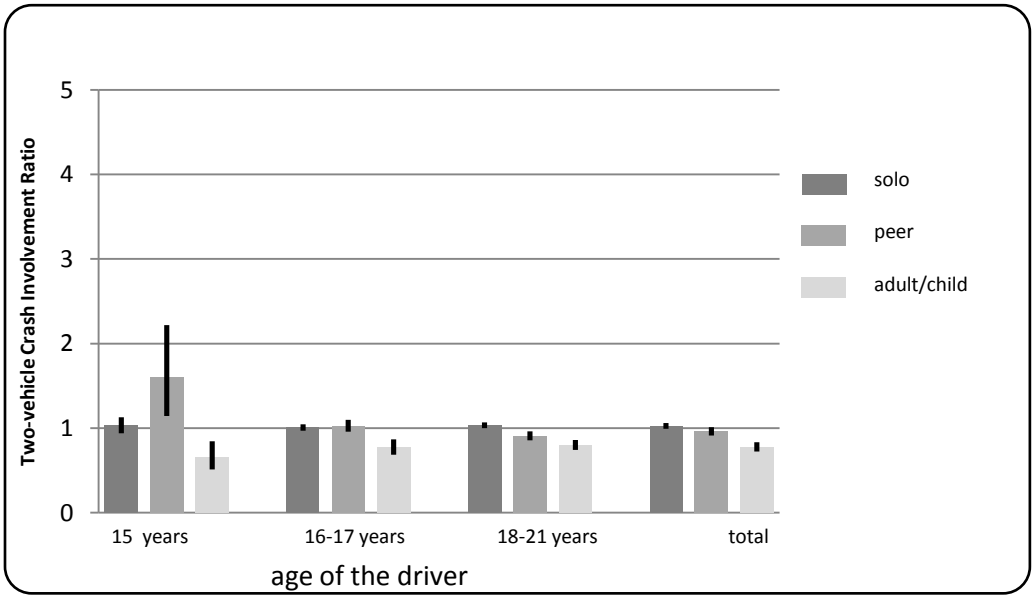

Figure 5.1.2: Two-vehicle Crash Involvement Ratio for Different Passenger Groups

5.2 According to the Driver Gender with Different Passenger Groups

The data was disaggregated by gender of the driver and as shown in the graphs below, it was found that the male drivers had a higher crash rate than the female drivers for both single-vehicle and two-vehicle crashes and for both group of drivers the presence of peer groups made them more prone to crashes.

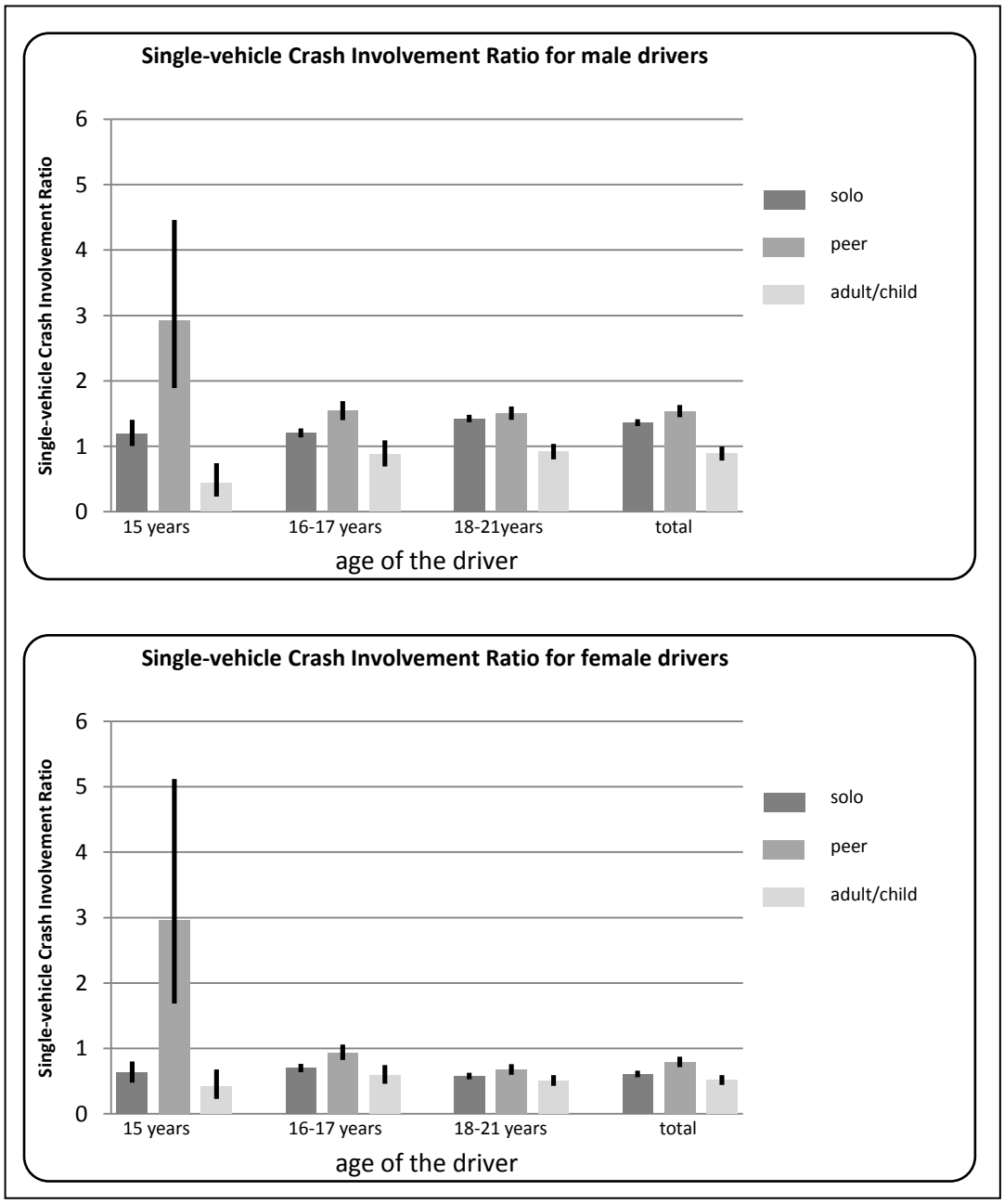

Figure 5.2.1: Single-vehicle Crash Involvement Ratio for Male and Female Drivers

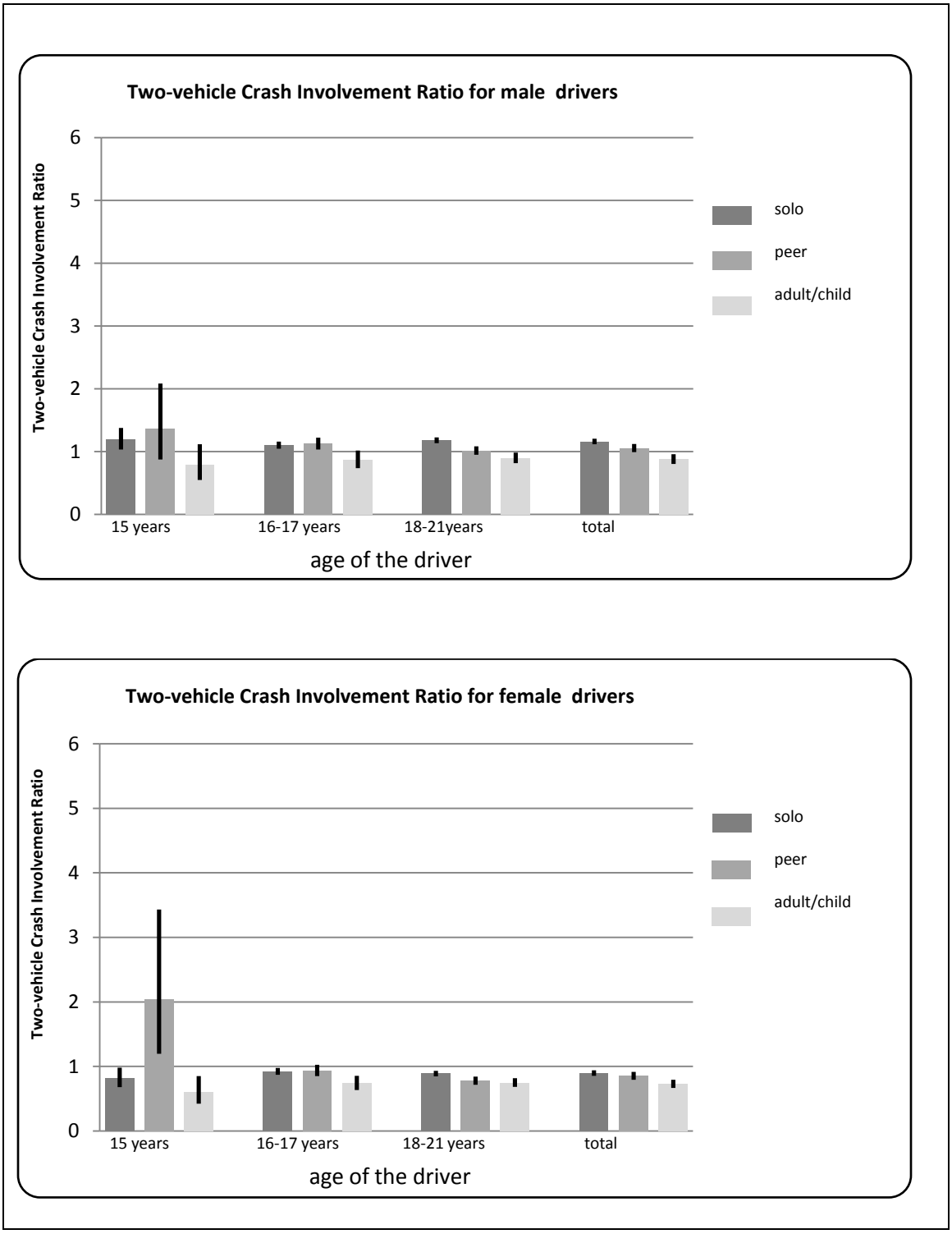

Figure 5.2.2: Two-vehicle Crash Involvement Ratio for Male and Female Drivers

Similar to the findings from passenger breakdown alone, the drivers below the 16 years of age traveling with peer group had the highest propensity to be involved in a crash and the drivers with the adult/child passengers had the lowest for both single-vehicle and two-vehicle crashes. This finding suggest that both young men and women drivers are more willing to take unnecessary risk when they are driving with peers in the car than when they are alone or have a child/adult in the vehicle with them.

5.3 According to Driver-Passenger Gender Combination

Passenger influence was investigated further to determine whether drivers behaved differently with passengers of the same gender versus a mixed occupancy. The crashes were divided into three sub categories based on the gender of the passengers and driver: all male, all female and mixed. The all male category indicates that the driver and other occupants are all male, and similarly for the all female group. The mixed category can have any combination of male and female passengers and drivers.

As shown in graphs in the figures 5.3.1 and 5.3.2, the single-vehicle and two-vehicle crash involvement ratios for the all male group (i.e. both the driver and passengers were male) were the highest in each passenger and driver group. This suggests that all male occupancy in a vehicle with a young driver behind the wheel has the highest propensity to be involved in a crash irrespective of the age of passenger with him. This may be due to the tendency of young males willing to take unnecessary risk even with someone elder to them along with them in the vehicle. But it has to be noted that drivers 15 years old are less dangerous with an adult or a child with him or her and the value goes up as they grow older. This means that adult supervision is necessary for the drivers of that age. The values in the other three groups mentioned are only marginal.

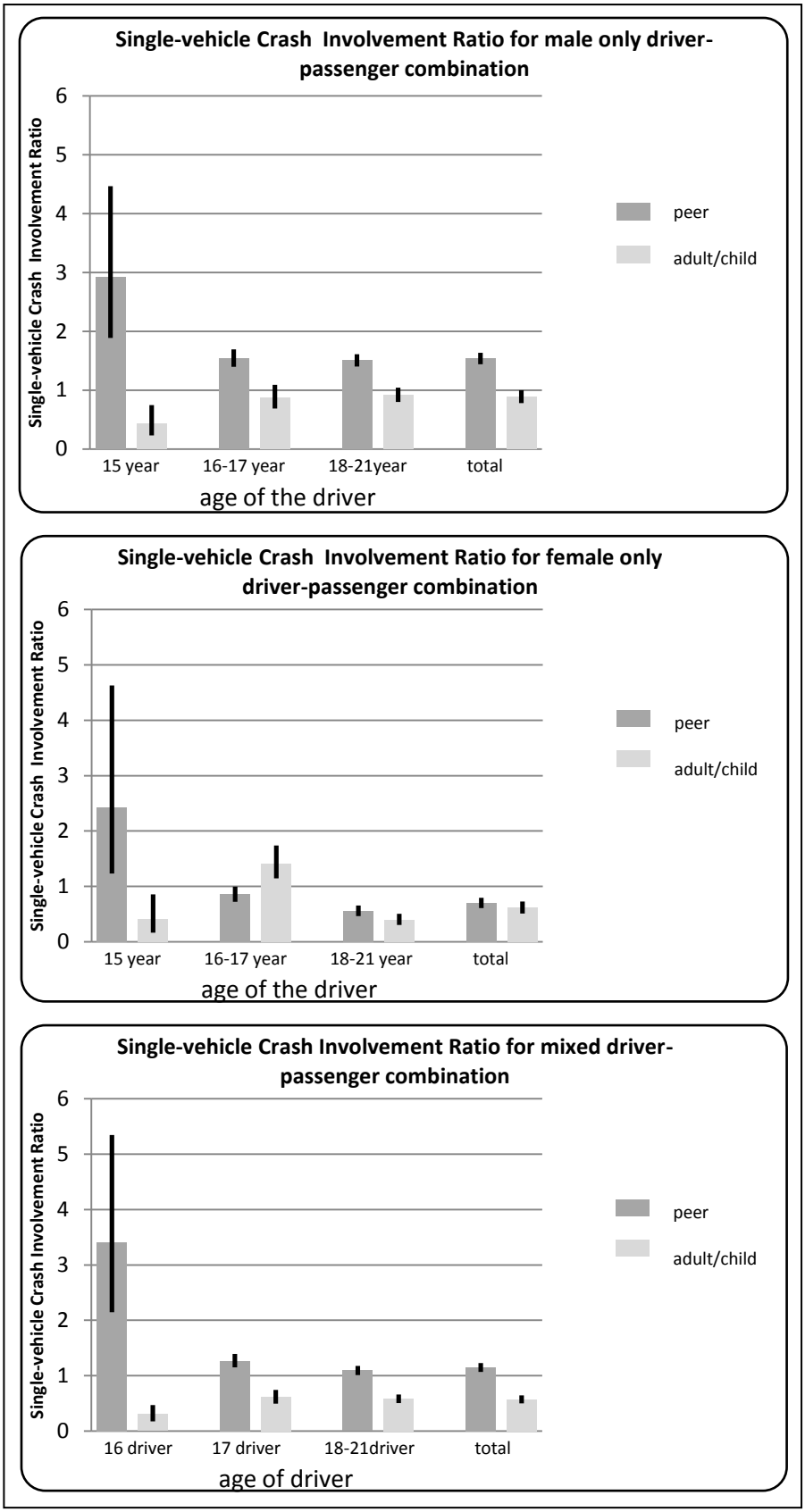

Figure 5.3.1: Single-vehicle Crash Involvement Ratio for Different Driver-Passenger Combination

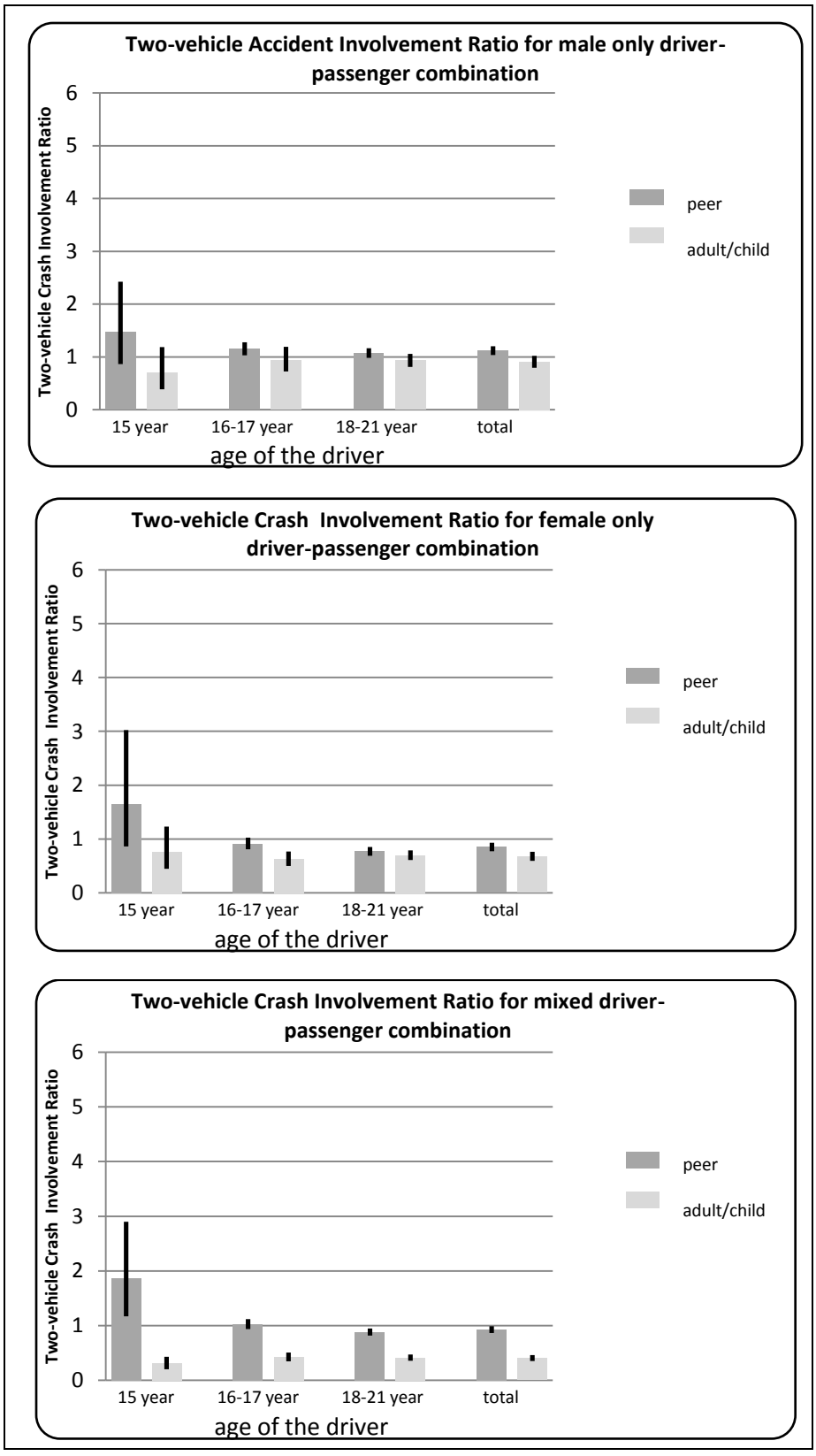

Figure 5.3.2: Two-vehicle Crash Involvement Ratio for Different Driver-Passenger Combination

The upper and lower limits confidence limits calculated by substitution method for the estimated RCIR value is exponential and is non-symmetrical and that accounts for the higher limit intervals when the RCIR value is more.

5.4 According to the Number of Occupants

The data was further analyzed to find out if there was any difference in RCIR values for crashes involving a young driver while travelling with various numbers of passengers in the vehicle for different passenger and driver groups. The number of passengers may reasonably affect peer pressure or distraction for younger drivers, increasing their likelihood to be involved in a crash with more passengers. Three groups of single passenger, two passengers and three or more passengers along with the young drivers were considered. The results are graphically represented in the Figures 5.4.1 and 5.4.2

The RCIR values for single-vehicle crashes for the peer group demonstrate that the crash propensity increases with an increase in the number of passengers. This increase in crash propensity with the peer category may be indicative of the fact that the driver must deal with increased peer pressure and distractions thus compromising the driving safety. The adult/child category for both single-vehicle and two-vehicle shows an almost stable trend with the RCIR values decreasing slightly with an increase in the number of passengers. This may be attributed to the fact that increased supervision or an increased sense of responsibility for multiple passengers, causes young drivers to be more cautious. The RCIR values for two-vehicle crashes for peer group do increase with increasing occupancy in the same manner as with single-vehicle crashes, but not as rapidly. Learner drivers (drivers less than 16 years of age) are clearly the most influenced by passengers.

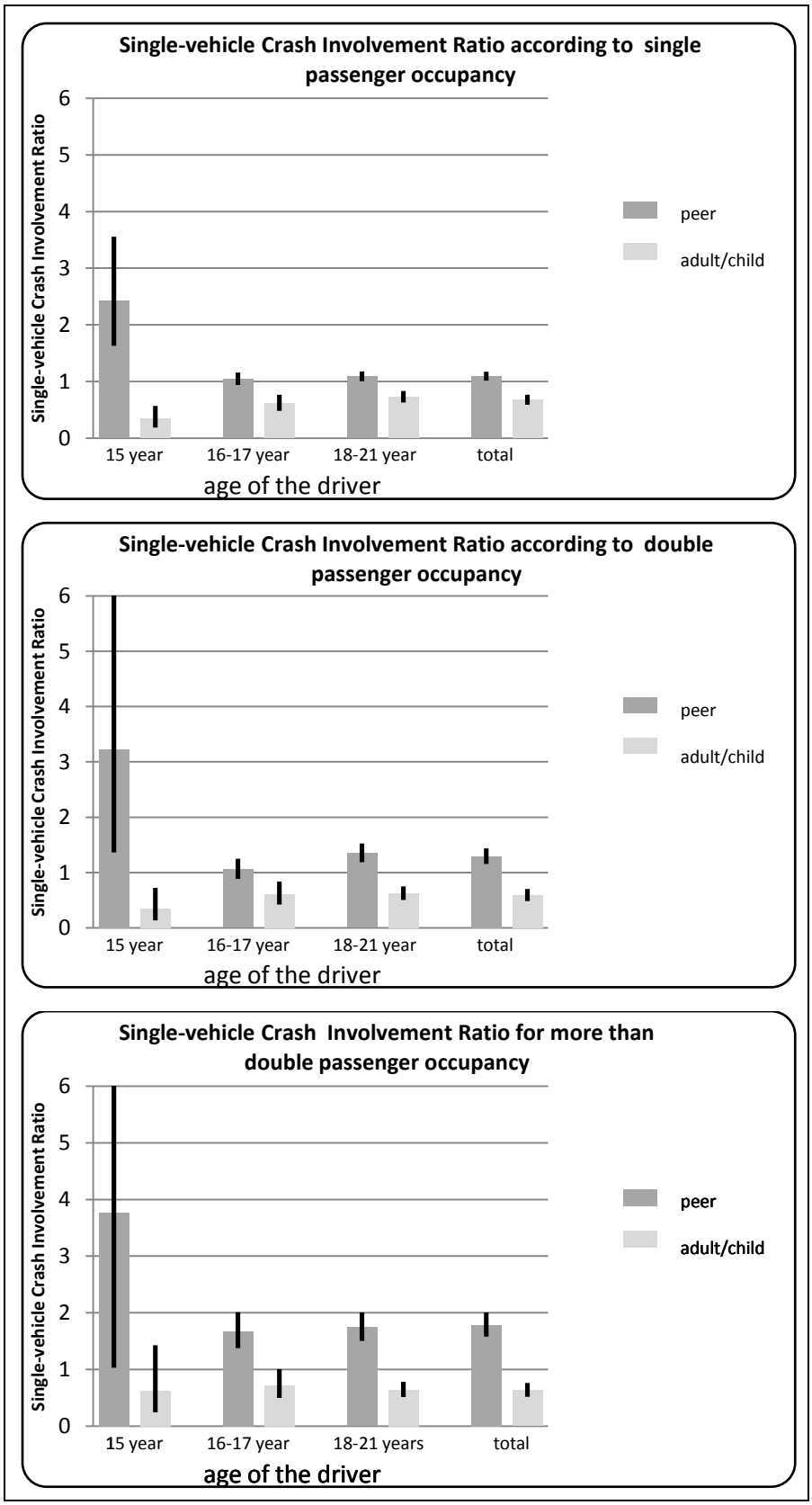

Figure 5.4.1: Single-vehicle Crash Involvement Ratio According to Number of Occupants

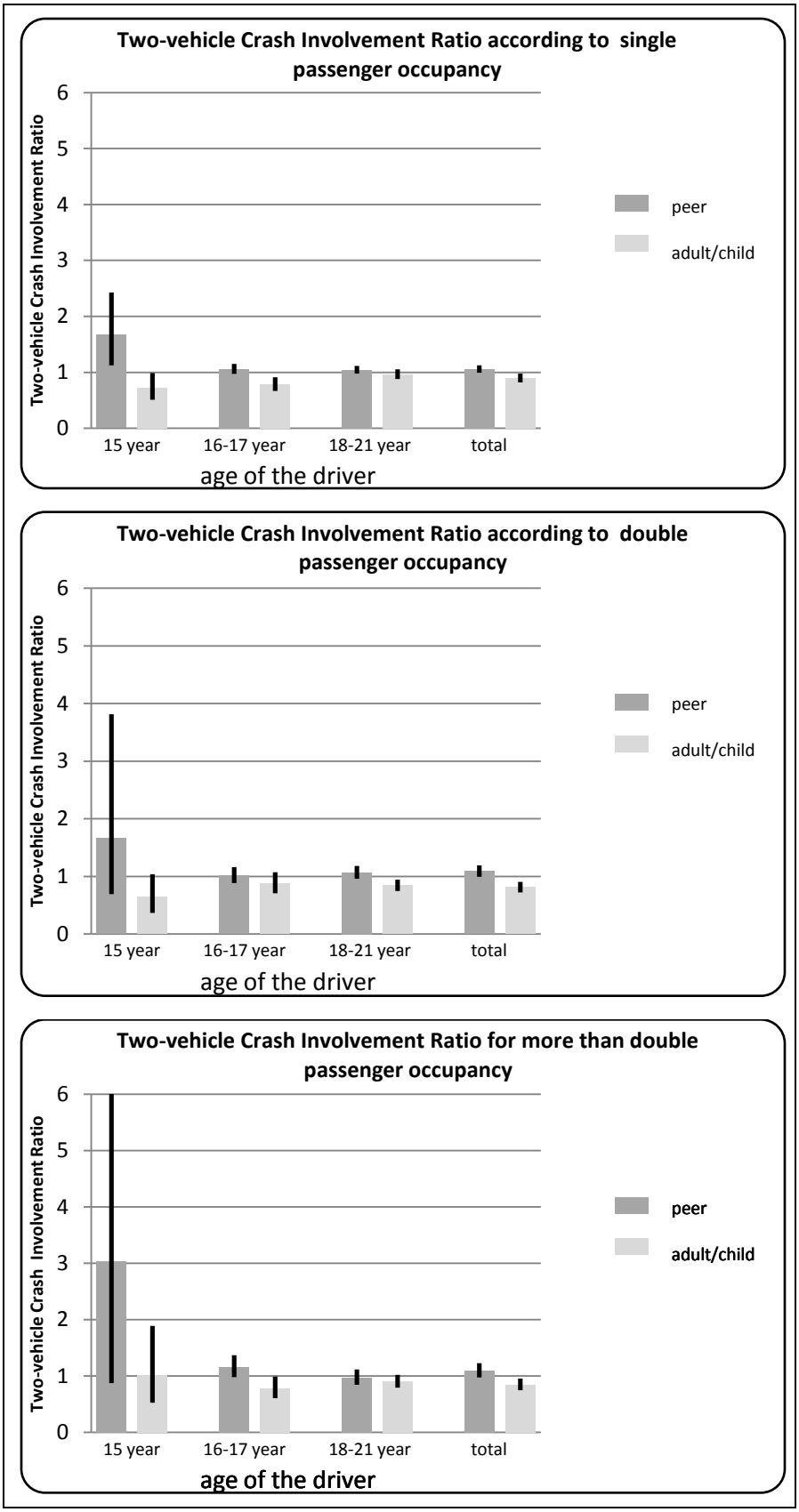

Table 5.4.2: Two-vehicle Crash Involvement Ratio According to Number of Occupants

5.5 According to the Time of Day

The driving skill of the young drivers during dark and various traffic conditions may vary depending on the presence or absence of passengers in the vehicle and Graduated Driver's License in Louisiana does clearly state that young drivers until the age of 17 are not supposed to drive unsupervised between 11 pm and 5 am. This prompted the comparison of crash rates during peak hours, off peak hours and after dark hours. The after dark hours was further categorized to find the crash rates during 11 pm and 5 am during which young drivers are not legally allowed to drive in Louisiana according to the GDL. The results are shown in the Figures 5.5.1 and 5.5.2.

It can be seen that the RCIR values for single-vehicle crashes are very high for young drivers below 18 years of age between 11 pm and 5 am even with adult supervision. This clearly states that young drivers should not be allowed to drive at all during that time of the night. Young drivers driving alone after dark hours have higher single-vehicle RCIR value than two-vehicle values, showing that young drivers are more susceptible to the conditions promoting single-vehicle crashes after dark than older drivers. It is also noted that two-vehicle RCIR values for the solo drivers are comparatively higher than other groups showing that there is a need to gain experience with supervision to maneuver the vehicle through traffic during daytime.

The value for the single-vehicle and two-vehicle crashes involving a 15 year old driver with an adult/child passenger between 11 pm and 5 am was not attainable as there was no two-vehicle crash reported during that time for the period of study in which the 15 year old driver involved was not-at-fault of the crash. Hence the denominator in the equation was zero and the crash involvement ratio was not computed.

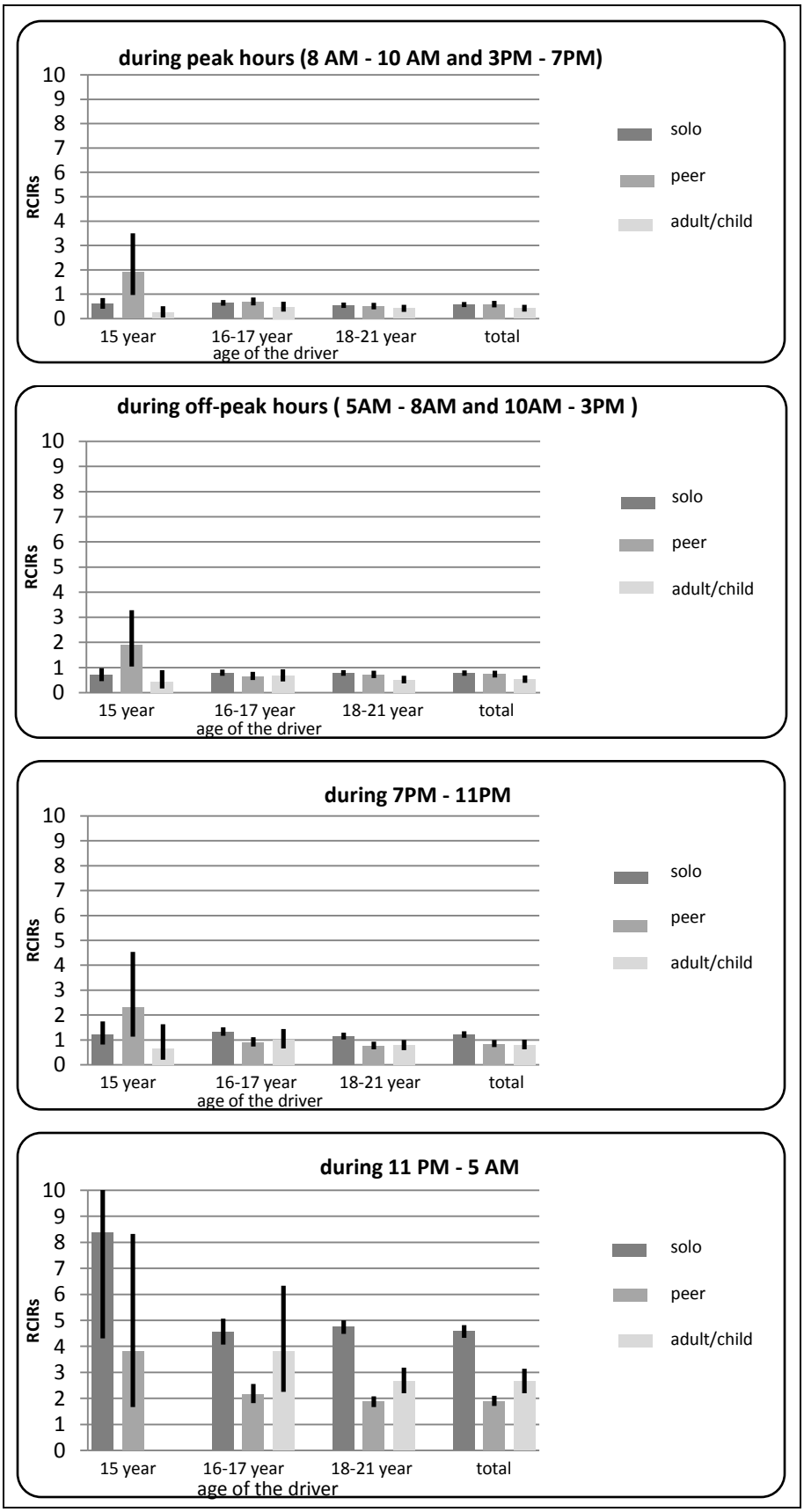

Figure 5.5.1: Single-vehicle Crash Involvement Ratio Related to the Time of the Day

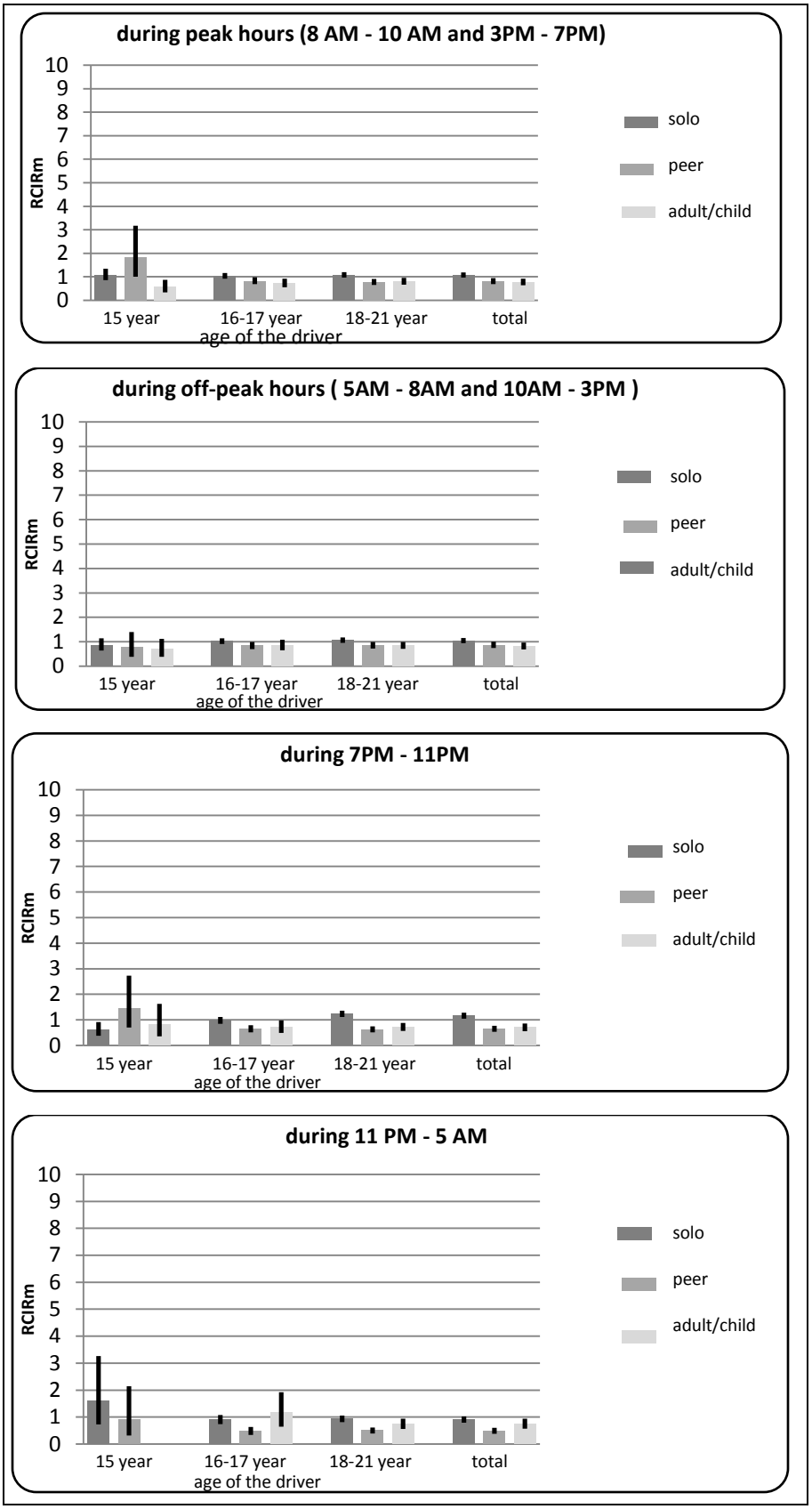

Figure 5.5.2: Two-vehicle Crash Involvement Ratio Related to the Time of the Day

5.6 According to the Day of the Week

In order to investigate if young drivers behave differently based on occupant categories on weekends versus weekdays, crashes based on the day of the week were considered. The assumptions made were that since the weekend has more social activities and may bring out an entirely different attitude towards driving, Friday, Saturday and Sunday should be grouped together, while the other days would be grouped together as working days. The results are shown in Figures 5.6.1 and 5.6.2.

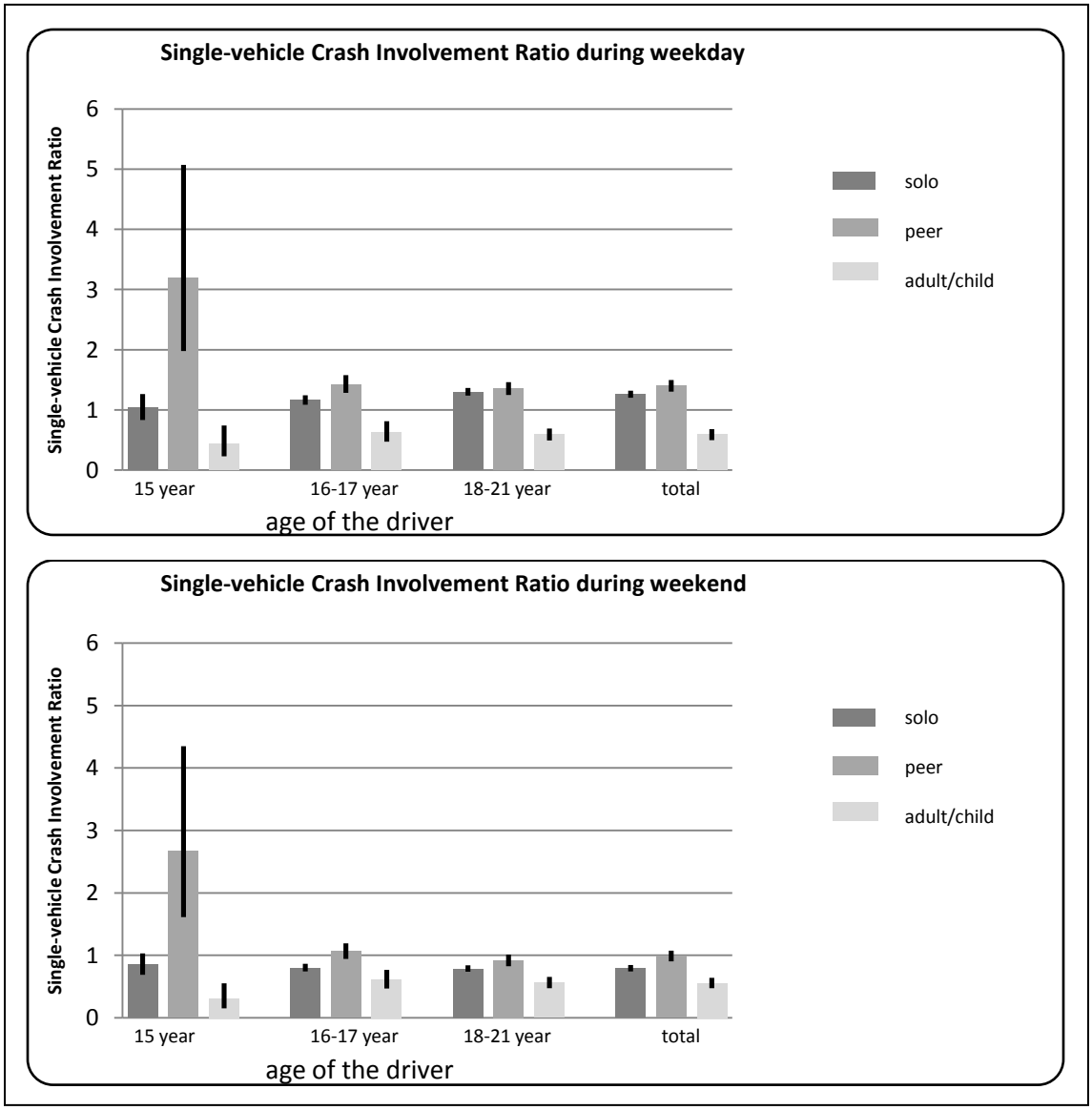

Figure 5.6.1: Single-vehicle Crash Involvement Ratio related to the day of the week

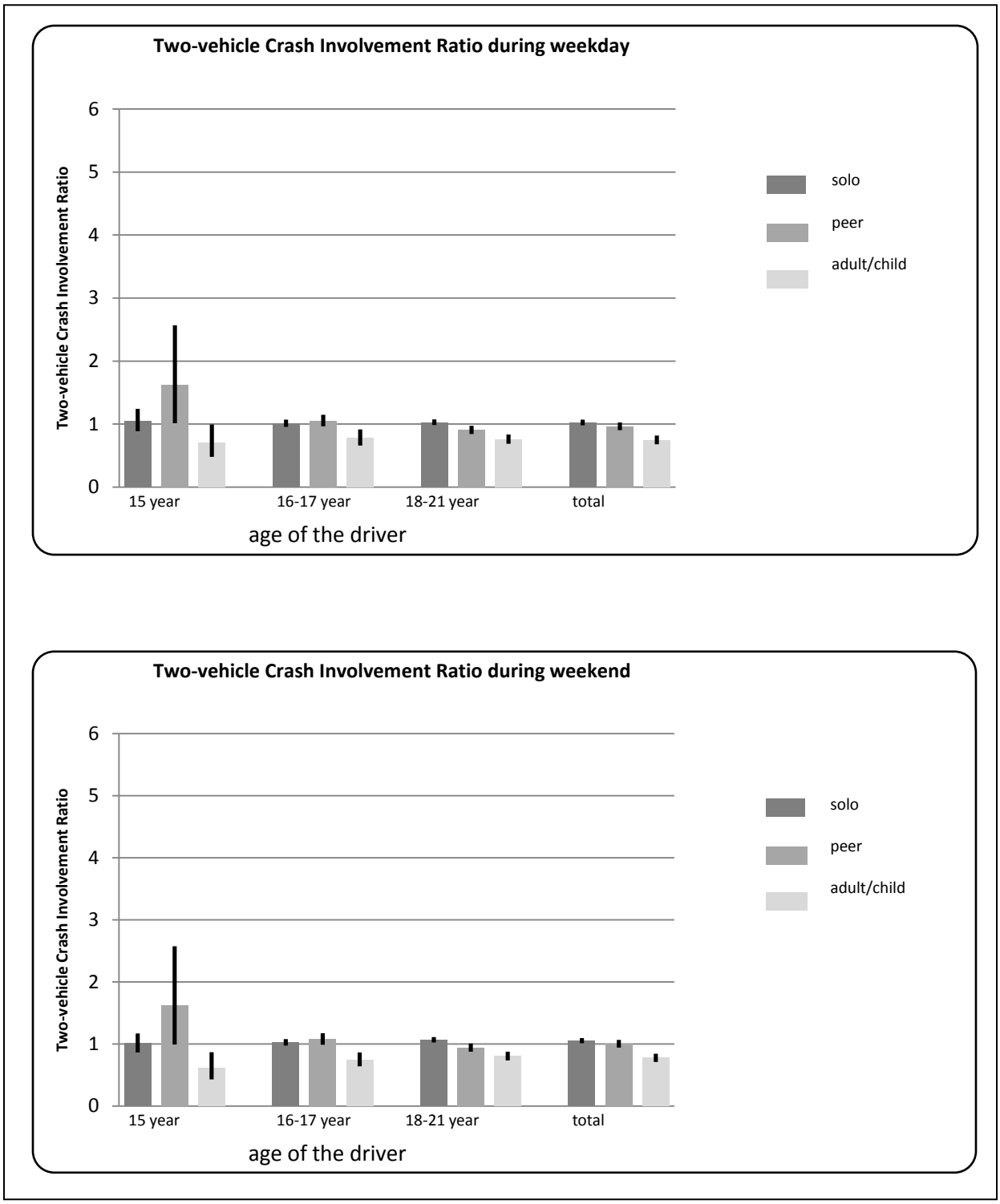

Figure 5.6.2: Two-vehicle Crash Involvement Ratio related to the day of the week

There wasn't much difference in RCIR values for two-vehicle for all groups of passenger and driver classifications showing that there is not much influence of the day of the week on

multi-vehicle crashes. However, RCIR values of single-vehicle crashes were higher over the weekend for solo group and peer group, which can be due to the social activities of young people during the weekends. It has to be noted that the RCIR value was particularly high for 15 year old drivers with peer group passenger throughout the week which infers that 15 year olds have high probability of having a crash at any time of the week when accompanied by peer.

5.7 With Respect to the Safety Restraint Used

In order to investigate the relation between the number of crashes and risk-taking behavior, crash incidence by use of safety restraint systems also considered. The notion is that the drivers who do not use the mandatory safety restraints display greater risk taking behavior. It was found, as represented in the figures 5.7.1 and 5.7.2, that the single-vehicle involvement ratios are very high when no safety restraints were used, suggesting that risk-taking young drivers have considerably higher crash rates than those who do not display those characteristics.

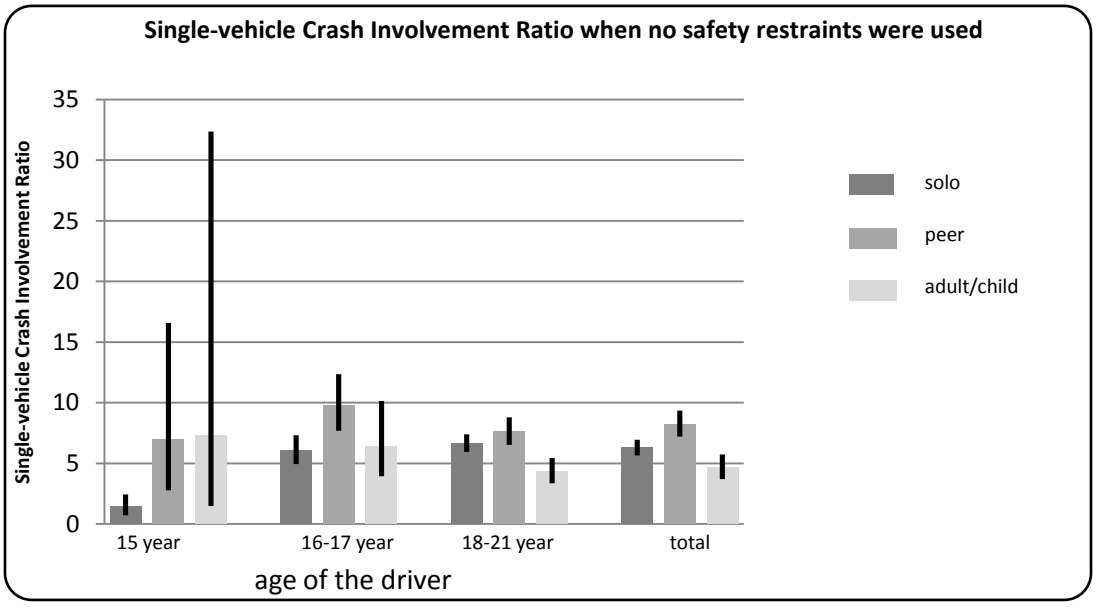

Figure 5.7.1(a): Single-vehicle Crash Involvement Ratio when no Safety Restraints were used

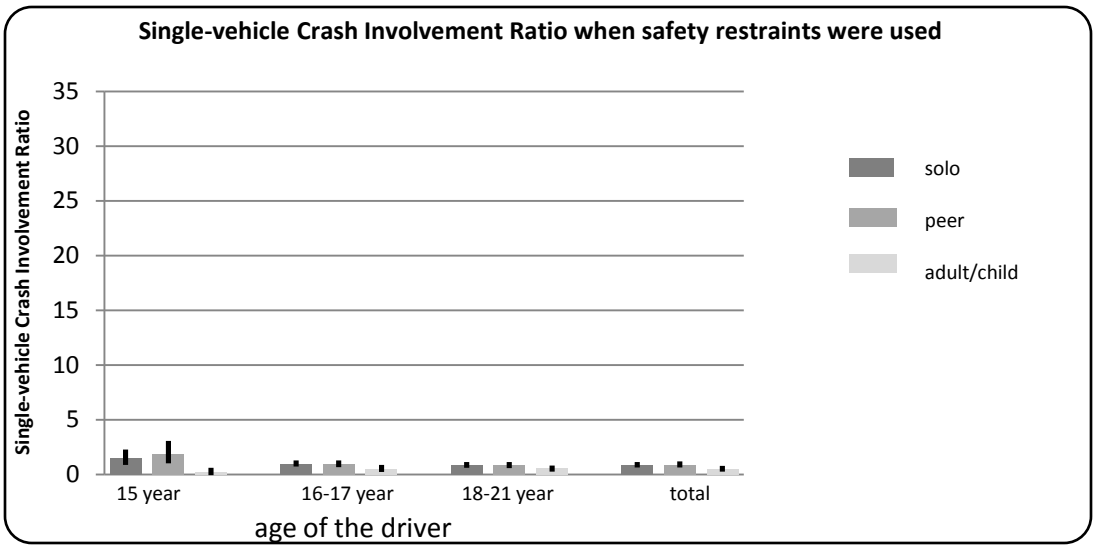

Figure 5.7.1(b): Single-vehicle Crash Involvement Ratio when Safety Restraints were used

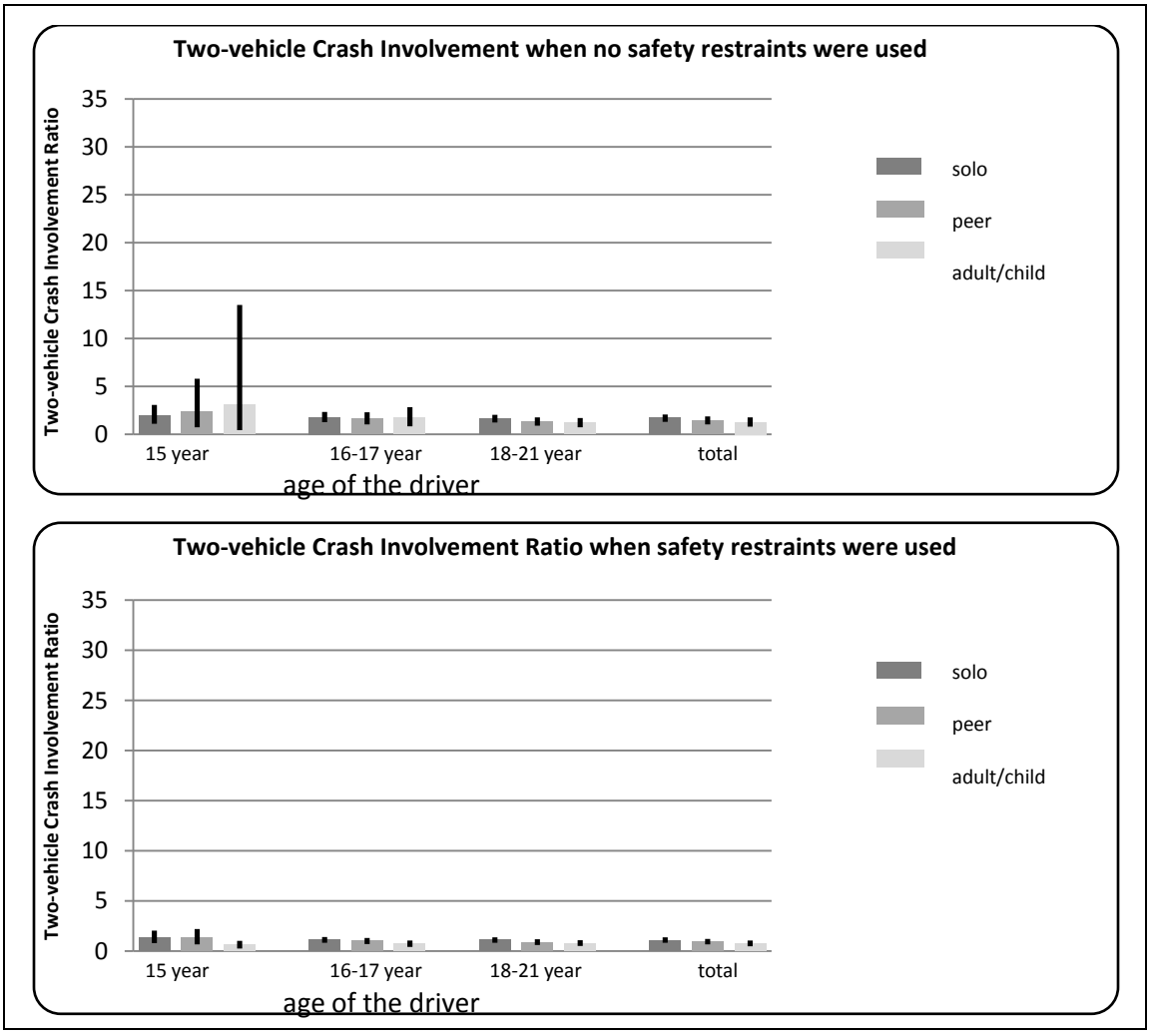

Figure 5.7.2: Two-vehicle Crash Involvement Ratio with Respect to the use of Safety Restraints

5.8 Comparison with Other Peer States

A similar study has been done by Aldridge et al. (1999) for the state of Kentucky for the years 1994-1996 and thus a comparison was done with the same. The values of the RCIR values of single-vehicle crashes and two-vehicle crashes for the state of Kentucky along with Louisiana are shown in table 5.8.1 and 5.8.2, respectively. The RCIR values of all groups except for the male drivers are almost same in value. The RCIR values of male drivers in Louisiana are higher than those of male drivers in Kentucky. This suggests young male drivers of Louisiana are more prone to be involved in a crash than their counterparts in Kentucky. It also has to be noted that the RCIR values of Kentucky are based on conditions before the introduction of Graduated Driver's License program in the state in November, 1996 and that of Louisiana is after the introduction of Graduated Driver's Licensing Law in January, 1998. It shows that though the current Graduated Driver's License program might have reduced the crash rates among young drivers (Mudumba, 2008); it could be made stricter to reduce the teenage crashes.

Table 5.8.1 Single-vehicle Crash Involvement Ratio for Louisiana and Kentucky

		RCIRs for Louisiana			RCIRs for Kentucky		
		solo	peer	adult/child	solo	peer	adult/child
passenger group		0.99	1.33	0.74	0.90	1.33	0.74
driver gender	male	1.36	1.54	0.89	0.89	1.32	0.76
	female	0.61	0.79	0.52	0.93	1.28	0.81
passenger-driver gender combination	male		1.69	1.10		1.05	0.78
	female		0.70	0.62		1.12	0.74
	mix		1.15	0.57		1.12	0.76
number of passengers	1		1.09	0.68		1.08	0.68
	2		1.29	0.59		1.28	0.54
	≥3		1.78	0.63		1.36	0.55

Table 5.8.2 Two-vehicle Crash Involvement Ratio for Louisiana and Kentucky

		RCIRm for Louisiana			RCIRm for Kentucky		
		solo	peer	adult/child	solo	peer	adult/child
passenger group		1.03	0.96	0.78	1.04	1.01	0.69
driver gender	male	1.16	1.06	0.88	1.05	0.98	0.65
	female	0.90	0.86	0.73	1.03	1.03	0.76
passenger-driver gender combination	male		1.12	0.90		1.06	0.68
	female		0.85	0.68		1.07	0.85
	mix		0.92	0.40		1.10	0.78
number of passengers	1		1.06	0.90		1.06	0.75
	2		1.09	0.81		1.17	0.72
	≥3		1.10	0.85		1.23	0.71

6. SUMMARY AND CONCLUSIONS

6.1 Study Summary

The study investigated the factors affecting young driver safety in Louisiana, using the six year crash data (1999-2004), obtained from LaDOTD. The final variables for the analysis were identified by an initial analysis of the data. Different variables which had an effect on the young driver safety were identified. Each identified variable was divided into three passenger categories and three driver age categories, and the crashes within each category were identified using Microsoft Access 2007 and SQL Queries.

The Relative Crash Involvement Ratio (RCIR), which is a measure of crash incidence, was calculated for each category using the Quasi-Induced Exposure technique. RCIR values greater than 1.0 indicated that the specific group was more likely to be involved in a crash and groups with values less than 1.0 are less likely to be involved in a crash.

The upper and lower limits for 95% confidence interval were calculated using the substitution method.

6.2 Conclusions

Based on the analyses and results reported in the previous chapter, the following conclusions were drawn from the present study:

- The passenger group has a significant effect on young driver safety especially those younger than 16 years.
- Young drivers have a substantially reduced chance of being involved in a crash when they travel with adults and/or children. On the other hand, they have an increased propensity to be involved in single-vehicle crashes when they are traveling with peers. This extends to multiple-vehicle crashes among learner drivers (less than 16 years of age)

when traveling with peers. The relative crash involvement ratios for both single-vehicle and two-vehicles crashes for young drivers traveling alone were close to 1.0 which suggests that risk taking in the presence of peers is a factor in young driver safety.

- It was found that the male drivers had a higher crash rate than the female drivers for both single-vehicle and two-vehicle crashes, and for both group of drivers the presence of peer groups made them more prone to crashes.
- It was observed that male only occupancy in a vehicle with a young driver has the highest propensity to cause a crash irrespective of the age of passenger which suggests that the young male do have a tendency to take unnecessary risk even with someone elder to them present in the vehicle.
- As the number of peer passengers increase, an increased propensity to be involved in a crash is observed. This suggests that as the driver deals with increased peer pressure and distractions, driver safety is compromised. In contrast, with an increase in supervision or increased sense of responsibility due to the presence of a child under 12 years of age in the vehicle, young drivers tend to be more cautious.
- It was observed that the single-vehicle crashes are high for young drivers during after dark hours from 7 pm to 5 am and particularly very high between 11 pm and 5 am even with adult supervision which means that night time driving conditions are susceptible and dangerous for young drivers.
- Young drivers were found to have higher single-vehicle crash rates during weekends which can be due to social activities of young people during weekends.
- It was also found that the drivers who do not use the mandatory safety restraints have higher crash rates than who use it. The notion was that drivers who do not use the safety

restraint and risk their life display greater risk taking behavior while driving and the results prove that risk-taking young drivers have considerably higher crash rates than those who do not display those characteristics.

6.3 Further Recommendations

This study was able to identify the factors affecting the safety of young drivers in the state of Louisiana and the findings reported here support restructuring of Louisiana's Graduated Driver's Licensing program as an effective way of reducing the teenage crashes. The high RCIR values obtained during the restricted 11 pm to 5 am period for learner drivers shows that the existing law has not been properly enforced, and its toll on young motorists is very high in terms of crash incidence. The findings in this analysis suggest that increased education and prolonged adult supervision for young drivers will be beneficial for developing them into safer drivers. The additions to the Graduated Driver's License Law recommended from the studies are:

- Implementing a minimum amount of supervision by a certified driving instructor with at least 5 to10 hours of night driving included in it;
- Restricting the number of passengers younger than 24 years old traveling with learner permit holders;
- Presence of an adult in the car during the learners and intermediate stage of licensing; and
- Extending the restriction for night time driving until the age of 18.

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APPENDIX A
EXISTING GRADUATED DRIVER'S LICENSE LAW IN VARIOUS STATES

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Alabama	15	6 mo.	30 hr.1 (none with driver education)	16	Midnight–6 a.m.	No more than 3 passengers (parents and guardians excepted)	17	17
Alaska	14	6 mo.	40 hr., 10 of which must be at night or in inclement weather	16	1 a.m.–5 a.m.	First 6 mo.: No passengers	16, 6 mo.	16, 6 mo.
Arizona	15, 6 mo.	6 mo.	30 hr., 10 of which must be at night	16	Midnight–5 a.m.	First 6 mo.: No more than 1 passenger younger than 18	16, 6 mo.	16, 6 mo.
Arkansas	14	6 mo.	None	There is no passenger or night driving restriction. The minimum license age is 16.				
California	15, 6 mo.	6 mo.	50 hr., 10 of which must be at night	16	11 p.m.–5 a.m.	First 12 mo.: No passengers younger than 20	17	17
Colorado	15	12 mo.	50 hr., 10 of which must be at night	16	Midnight–5 a.m.	First 6 mo.: No passengers Second 6 mo.: No more than 1 passenger	17	17

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Connecticut	16	6 mo. (4 mo. with driver education)	up to 20 hr.[6]	16, 4 mo.	Midnight–5 a.m.	First 3 mo.: No passengers other than a parent if there is a supervising driver present Second 3 mo.: No passengers (family members excepted)	18	16, 10 mo.
Delaware	16	6 mo.	50 hr., 10 of which must be at night	16, 6 mo.	10 p.m.–6 a.m.	No more than 1 passenger	17	17
District of Columbia	16	6 mo.	40 hr. in learner's stage; 10 hr. at night in intermediate stage	16,6 mo.	September–June: 11pm - 6am (Su-Th) 12 am - 6 am (Sa-Su) July- August: 12 am -6 am	First 6 mo.: No passengers; Thereafter, no more than 2 passengers	18	18
Florida	15	12 mo.	50 hr., 10 of which must be at night	16	11 p.m.–6 a.m. (age 16), 1 a.m.–5 a.m. (age 17)	None	18	—

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Georgia	15	12 mo.	40 hr., 6 of which must be at night	16	Midnight–6 a.m.	First 6 mo.: No passengers Second 6 mo.: No more than 1 passenger younger than 21 thereafter, No more than 3 passengers	18	18
Hawaii	15,6mo.	6 mo.	None	16	11 p.m.–5 a.m.	No more than 1 passenger younger than 18	17	17
Idaho	14, 6 mo.	6 mo.	50 hr., 10 of which must be at night	15	Sunset to sunrise	First 6 mo.: Licensees 16 and younger can have no more than 1 passenger younger than 17	16	15, 6 mo.
Illinois	15	3 mo.	50 hr., 10 of which must be at night	16	Starts 11 p.m. Su–Th midnight Fri–Sat, ends 6 a.m.	First 6 mo.: No more than 1 passenger younger than 20	17	16, 6 mo.

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Iowa	14	6 mo.	20 hr., 2 of which must be at night	16	12:30 a.m.–5 a.m.	None	17	—
Kansas	14	6 mo.	25 hr., in learner phase; 25 hr. before age 16; 10 of the 50 hr must be at night	There is no intermediate stage. The minimum license age is 16.			—	—
Kentucky	16	6 mo.	60 hr., 10 of which must be at night	16,6 mo.	Midnight–6 a.m.	No more than 1 passenger younger than 20 unless supervised by a driving instructor	17	17
Louisiana	15	6 mo.	None	16	11 p.m.–5 a.m.	None	17	—
Maine	15	6 mo.	35 hr., 5 of which must be at night	16	Midnight–5 a.m.	First 180 days: No passengers	16, 6 mo.	16, 6 mo.

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Maryland	15, 9 mo.	6 mo.	60 hr., 10 of which must be at night	16, 3 mo.	Midnight–5 a.m.	First 5 mo.: No passengers younger than 18	17, 9 mo.	16, 8 mo.
Massachusetts	16	6 mo.	40 hr.	16, 6 mo.	12:30 a.m.–5 a.m.	First 6 mo.: No passengers younger than 18	18	17
Michigan	14, 9 mo.	6 mo.	50 hr., 10 of which must be at night	16	Midnight–5 a.m.	None	17	—
Minnesota	15	6 mo.	30 hr., 10 of which must be at night	A provisional license may be granted at 16. There are no passenger or nighttime restrictions.			—	—
Mississippi	15	6 mo.	None	15,6 mo.	10 p.m.–6 a.m.	None	16	—
Missouri	15	6 mo.	40 hr., 10 of which must be at night	16	1 a.m.–5 a.m.	First 6 mo.: No more than 1 passenger younger than 19 Thereafter: No more than 3 passengers younger than 19	17, 11 mo.	17, 11 mo.

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	*Mandatory Holding Period*	*Min Amount of Supervised Driving*	*Minimum Age*	*Unsupervised Driving Prohibited*	*Restriction on Passengers*	*Nighttime Restriction*	*Passenger Restriction*
Montana	14,6 mo.	6 mo.	50 hr., 10 of which must be at night	15	11 p.m.-5 a.m.	First 6 mo.: No more than 1 passenger younger than 18 Second 6mo.: No more than 3 passengers younger than 18	16	16
Nebraska	15	6 mo.	50 hr., 10 of which must be at night	16	Midnight–6 a.m.	First 6 mo.: No more than 1 passenger younger than 19	17	16, 6 mo.
Nevada	15,6 mo.	6 mo	50 hr., 10 of which must be at night	16	10 p.m.–5 a.m.	First 3 mo.: No passengers younger than 18	18	16, 3 mo.
New Hampshire	15,6 mo.	None	20 hr.	16	1 a.m.–5 a.m.	First 6 mo.: No more than 1 passenger younger than 25	17, 1 mo.	16, 6 mo.
New Jersey	16	6 mo.	None	17	Midnight–5 a.m.	No more than 1 passenger	18	18

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
New Mexico	15	6 mo.	50 hr., 10 of which must be at night	15,6 mo.	Midnight–5 a.m.	No more than 1 passenger younger than 21	16, 6 mo.	16, 6 mo.
New York	16	up to 6 mo.	20 hr.	16, 6 mo.	9 p.m.–5 a.m.	No more than 2 passenger younger than 21	17	17
North Carolina	15	12 mo.	None	16	9 p.m.–5 a.m.	No more than 1 passenger younger than 21 (family members exempted);if a family member younger than 21 is already a passenger then no other passengers	16, 6 mo.	16, 6 mo.
North Dakota	14	6 mo.	None	There is no intermediate stage. The minimum license age is 16.			—	—
Ohio	15,6 mo.	6 mo.	50 hr., 10 of which must be at night	16	Midnight–6 a.m. (age 16)1 a.m.–5 a.m. (age 17)	No more than 1 passenger	18	17

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	*Mandatory Holding Period*	*Min Amount of Supervised Driving*	*Minimum Age*	*Unsupervised Driving Prohibited*	*Restriction on Passengers*	*Nighttime Restriction*	*Passenger Restriction*
Oklahoma	15, 6 mo.	6 mo.	40 hr., 10 of which must be at night	16	11 p.m.–5 a.m.	No more than 1 passenger (household members excepted)	16, 6 mo.	16, 6 mo.
Oregon	15	6 mo.	50 hr.	16	Midnight–5 a.m.	First 6 mo.: No passengers younger than 20 Second 6 mo.: No more than 3 passengers younger than 20	17	17
Pennsylvania	16	6 mo.	50 hr.	16, 6 mo.	11 p.m.–5 a.m.	None	17	—
Rhode Island	16	6 mo.	50 hr., 10 of which must be at night	16, 6 mo.	1 a.m.–5 a.m.	First 12 mo.: No more than I passenger younger than 20	17, 6 mo.	17, 6 mo.
South Carolina	15	6 mo.	40 hr., 10 of which must be at night	15, 6 mo.	6 p.m.–6 a.m. EST, 8 p.m.–6 a.m. EDT	No more than 2 passengers younger than 21	16, 6 mo.	16, 6 mo.

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
South Dakota	14	6 mo.(3 mo.with driver education)	None	14, 6 mo.	10 p.m.–6 a.m.	None	16	—
Tennessee	15	6 mo.	50 hr., 10 of which must be at night	16	11 p.m.–6 a.m.	No more than 1 passenger	17	17
Texas	15	6 mo.	None	16	Midnight–5 a.m.	No more than 1 passenger younger than 21	16, 6 mo.	16, 6 mo.
Utah	15	6 mo.	40 hr., 10 of which must be at night	16	Midnight–5 a.m.	First 6 mo.: No passengers	17	16, 6 mo
Vermont	15	1 yr.	40 hr., 10 of which must be at night	16	None	First 6 mo.: No passengers without exception	—	16, 6 mo.
Virginia	15	9 mo.	40 hr., 10 of which must be at night	16, 3 mo.	Midnight-4 a.m.	First 12 mo.: No more than 1 passenger younger than 18; thereafter, no more than 3 passengers 18	18	18

Jurisdiction/Evaluation	*Learner Stage*			*Intermediate Stage Restrictions on Driving while Unsupervised*			*Minimum Age at Which Restrictions May Be Lifted*	
	Min Entry Age	***Mandatory Holding Period***	***Min Amount of Supervised Driving***	***Minimum Age***	***Unsupervised Driving Prohibited***	***Restriction on Passengers***	***Nighttime Restriction***	***Passenger Restriction***
Washington	15	6 mo.	50 hr., 10 of which must be at night	16	1 a.m.–5 a.m.	First 6 mo.: No passengers younger than 20 Second 6 mo.: No more than 3 passengers younger than 20	17	17
West Virginia	15	6 mo.	30 hr. (none with driver education)	16	11 p.m.–5 a.m.	No more than 3 passengers younger than 19	17	17
Wisconsin	15,6 mo.	6 mo.	30 hr., 10 of which must be at night	16	Midnight–5 a.m.	No more than 1 passenger	16, 9 mo.	16, 9 mo.
Wyoming	15	10 days	50 hr., 10 of which must be at night	16	11 p.m.–5 a.m.	No more than 1 passenger younger than 18	16, 6 mo.	16, 6 mo.

APPENDIX B
TOTAL NUMBER OF CRASHES FOR DIFFERENT CIRCUMSTANCES FOR THE YEARS 1999 TO 2004 IN THE STATE OF LOUISIANA

		driver age	Single-vehicle crashes			two-vehicle crashes					
			driver at-fault			driver not-at-fault (no violation)			driver at-fault		
			solo	peer	adult/child	solo	peer	adult/child	solo	peer	adult/child
			(driver alone in the vehicle)	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*	*(driver alone in the vehicle)*	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*	*(driver alone in the vehicle)*	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*
passenger group		less than 16	366	126	48	402	45	119	1087	189	207
		16 and 17	6986	1815	303	16053	3226	940	34794	7133	1566
		18 -21	19356	3607	1165	58927	9689	5402	93050	13443	6604
		total	26708	5548	1516	75382	12960	6461	128931	20765	8377
driver gender	male	less than 16	253	78	22	222	28	53	696	100	110
		16 and 17	4478	1149	152	8255	1655	386	19561	4004	723
		18-21	13848	2666	604	29837	5434	2023	53847	8423	2773
		total	18579	3893	778	38314	7117	2462	74104	12527	3606
	female	less than 16	113	48	26	189	17	66	408	91	106
		16 and 17	2508	666	151	7949	1581	564	15821	3188	899
		18-21	5508	941	561	29224	4265	3389	39776	5081	3888
		total	8129	1655	738	37362	5863	4019	56005	8360	4893
passenger-driver gender combination	male only	less than 16		57	17		20	24		77	44
		16 and 17		741	70		1031	138		2551	278
		18-21		1647	320		3012	880		4936	1248
		total		2445	407		4063	1042		7564	1570
	female only	less than 16		30	11	`	13	28		56	56
		16 and 17		408	197		1058	308		2082	415
		18-21		460	197		2522	1506		2963	1605
		total		898	405		3593	1842		5101	2076
	mix of male and female	less than 16		78	39		24	133		117	107
		16 and 17		1317	268		2306	965		5084	881
		18-21		2982	1116		8365	5876		11254	3704
		total		4377	1423		10695	6974		16455	4692

		driver age	Single-vehicle crashes			two-vehicle crashes					
			driver at-fault			driver not-at-fault (no violation)			driver at-fault		
			solo	peer	adult/child	solo	peer	adult/child	solo	peer	adult/child
			(driver alone in the vehicle)	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*	*(driver alone in the vehicle)*	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*	*(driver alone in the vehicle)*	*(passenger age between 12 and 24)*	*(atleast one passenger not between age 12 and 24)*
number of passengers	1	less than 16		90	27		35	74		141	129
		16 and 17		1233	176		2319	563		5129	925
		18-21		2604	673		7541	2924		10474	3747
		total		3927	876		9895	3561		15744	4801
	2	less than 16		24	11		7	30		28	46
		16 and 17		327	67		608	218		1290	399
		18-21		606	279		1422	1423		2012	1587
		total		957	357		2037	1671		3330	2032
	3 and more	less than 16		12	10		3	15		22	37
		16 and 17		255	60		300	164		729	268
		18-21		397	213		721	1051		934	1264
		total		664	283		1024	1230		1685	1569
day of the week	Weekend	less than 16	182	70	23	184	23	55	508	98	101
		16 and 17	3517	1020	115	6704	1587	405	14595	3598	680
		18-21	10273	2174	457	24197	4926	2378	38054	6818	2760
		total	13972	3264	595	31085	6536	2838	53157	10514	3541
	Weekday	less than 16	184	56	19	227	22	64	599	93	104
		16 and 17	3469	795	150	9594	1657	547	21159	3844	880
		18-21	9083	1433	561	35339	4799	3067	57504	6884	3771
		total	12736	2284	730	45160	6478	3678	79262	10821	4755

		driver age	Single-vehicle crashes			Two-vehicle crashes					
			driver at-fault			driver not-at-fault (no violation)			driver at-fault		
			solo *(driver alone in the vehicle)*	peer *(passenger age between 12 and 24)*	adult/child *(atleast one passenger not between age 12 and 24)*	solo *(driver alone in the vehicle)*	peer *(passenger age between 12 and 24)*	adult/child *(atleast one passenger not between age 12 and 24)*	solo *(driver alone in the vehicle)*	peer *(passenger age between 12 and 24)*	adult/child *(atleast one passenger not between age 12 and 24)*
time of the day	peak hours (8 AM - 10 AM and 3PM - 7PM)	less than 16	109	31	16	186	17	67	534	82	103
		16 and 17	2061	508	102	7042	1607	467	15908	2882	739
		18-21	4346	711	305	24036	4229	2214	39975	5075	2754
		total	6516	1250	423	31264	5853	2748	56417	8039	3596
	off-peak hours (5AM - 8AMand 10AM - 3PM)	less than 16	92	38	16	137	21	37	313	43	67
		16 and 17	2129	396	95	5933	1322	314	13017	2388	578
		18-21	5799	760	331	22616	3199	1968	36784	4145	2532
		total	8020	1194	442	28686	4542	2319	50114	6576	3177
	7PM - 11PM	less than 16	82	29	9	70	13	14	114	49	30
		16 and 17	1497	474	63	2484	1141	139	5233	1585	213
		18-21	3091	744	225	8218	2954	877	15463	2813	961
		total	4670	1247	297	10772	4108	1030	20810	4447	1204
	11 PM - 5 AM	less than 16	80	29	7	10	8	0	42	19	9
		16 and 17	1323	440	43	646	451	25	1255	466	62
		18-21	6184	1413	306	4004	2320	353	5700	1761	396
		total	7587	1882	356	4660	2779	378	6997	2246	467
safety restraint usage(shoulder belt/lapbelt or both)	no safety restraint used	less than 16	45	40	14	33	6	2	169	37	16
		16 and 17	545	436	78	200	99	27	767	347	98
		18-21	1932	909	253	893	367	180	2228	744	328
		total	2522	1385	345	1126	472	209	3164	1128	442
	some safety restraint used	less than 16	84	59	26	59	33	107	210	116	173
		16 and 17	2156	1188	192	4773	2712	797	11397	5854	1223
		18-21	6186	2234	781	21608	7954	4466	36328	10748	5349
		total	8426	3481	999	26440	10699	5370	47935	16718	6745

APPENDIX C
CALCULATED RCIR VALUES FOR SINGLE-VEHICLE AND TWO-VEHICLE CRASHES FOR DIFFERENT CIRCUMSTANCES FOR THE YEARS 1999 TO 2004 IN THE STATE OF LOUISIANA

LL denotes the lower limit of the confidence interval, UL denotes the upper limit of confidence interval and EST denotes the estimated RCIR value

Single-vehicle Crash Involvement Ratio for Different Passenger Groups

category	driver age	RCIRs								
		solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
		LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
passenger group	less than 16	0.88	0.95	1.03	2.13	2.93	4.04	0.31	0.42	0.58
	16 and 17	0.95	0.97	0.98	1.19	1.25	1.32	0.63	0.72	0.81
	18 -21	1.00	1.01	1.01	1.10	1.14	1.18	0.62	0.66	0.70
	total	0.99	0.99	1.00	1.17	1.20	1.24	0.62	0.66	0.70

Two-vehicle Crash Involvement Ratio for Different Passenger Groups

category	driver age	RCIRm								
		solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
		LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
passenger group	less than 16	0.97	1.03	1.10	1.18	1.60	2.19	0.54	0.66	0.81
	16 and 17	1.00	1.01	1.02	0.99	1.03	1.07	0.72	0.77	0.84
	18 -21	1.03	1.03	1.04	0.89	0.91	0.93	0.77	0.80	0.83
	total	1.02	1.03	1.03	0.94	0.96	0.98	0.75	0.78	0.80

Single-vehicle Crash Involvement Ratio for Male and Female Drivers

category		driver age	RCIRs								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
driver gender	male	less than 16	1.04	1.19	1.37	1.93	2.92	4.42	0.27	0.44	0.71
		16 and 17	1.17	1.20	1.24	1.44	1.54	1.66	0.73	0.87	1.05
		18 -21	1.40	1.42	1.44	1.44	1.51	1.57	0.84	0.92	1.00
		total	1.34	1.36	1.38	1.48	1.54	1.59	0.82	0.89	0.96
	female	less than 16	0.51	0.63	0.77	1.72	2.96	5.08	0.27	0.41	0.64
		16 and 17	0.67	0.70	0.73	0.86	0.94	1.02	0.50	0.59	0.71
		18 -21	0.56	0.58	0.59	0.63	0.68	0.73	0.46	0.51	0.55
		total	0.60	0.61	0.62	0.75	0.79	0.84	0.48	0.52	0.56

Two-vehicle Crash Involvement Ratio for Male and Female Drivers

category		driver age	RCIRm								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
driver gender	male	less than 16	1.07	1.20	1.34	0.91	1.36	2.05	0.58	0.79	1.08
		16 and 17	1.08	1.10	1.12	1.06	1.12	1.19	0.77	0.87	0.98
		18 -21	1.17	1.18	1.19	0.98	1.01	1.05	0.85	0.90	0.95
		total	1.15	1.16	1.17	1.03	1.06	1.09	0.84	0.88	0.92
	female	less than 16	0.71	0.82	0.95	1.23	2.04	3.40	0.46	0.61	0.82
		16 and 17	0.91	0.93	0.95	0.88	0.94	0.99	0.67	0.74	0.82
		18 -21	0.88	0.89	0.90	0.75	0.78	0.81	0.72	0.75	0.79
		total	0.89	0.90	0.91	0.83	0.86	0.88	0.70	0.73	0.76

Single-vehicle Crash Involvement Ratio for Different Driver-Passenger Combination

category		driver age	RCIRs					
			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*
passenger driver gender combination	male only	less than 16	1.82	2.99	4.90	0.40	0.74	1.37
		16 and 17	1.46	1.60	1.75	0.85	1.13	1.50
		18 -21	1.58	1.68	1.78	0.98	1.12	1.27
		total	1.61	1.69	1.77	0.98	1.10	1.23
	female only	less than 16	1.28	2.42	4.59	0.21	0.41	0.82
		16 and 17	0.77	0.86	0.96	1.19	1.42	1.70
		18 -21	0.51	0.56	0.62	0.35	0.40	0.47
		total	0.65	0.70	0.75	0.55	0.62	0.69
	mix of male and female	less than 16	2.19	3.41	5.30	0.22	0.31	0.43
		16 and 17	1.19	1.27	1.35	0.54	0.62	0.70
		18 -21	1.05	1.09	1.14	0.55	0.58	0.62
		total	1.11	1.15	1.19	0.54	0.57	0.61

Two-vehicle Crash Involvement Ratio for Different Driver-Passenger Combination

category		driver age	RCIRm					
			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*
passenger driver gender combination	male only	less than 16	0.91	1.47	2.38	0.43	0.70	1.14
		16 and 17	1.07	1.15	1.23	0.76	0.94	1.15
		18 -21	1.03	1.07	1.12	0.85	0.93	1.01
		total	1.08	1.12	1.16	0.84	0.90	0.98
	female only	less than 16	0.91	1.64	2.98	0.49	0.76	1.19
		16 and 17	0.85	0.91	0.98	0.54	0.63	0.73
		18 -21	0.73	0.77	0.81	0.65	0.70	0.75
		total	0.82	0.85	0.89	0.64	0.68	0.72
	mix of male and female	less than 16	1.21	1.86	2.86	0.24	0.31	0.39
		16 and 17	0.98	1.02	1.07	0.39	0.42	0.46
		18 -21	0.86	0.88	0.90	0.40	0.41	0.43
		total	0.90	0.92	0.94	0.39	0.40	0.42

Single-vehicle Crash Involvement Ratio According to Number of Occupants

category		driver age	RCIRs					
			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*
number of passengers	1	less than 16	1.67	2.42	3.52	0.22	0.34	0.53
		16 and 17	0.98	1.05	1.12	0.52	0.61	0.73
		18 -21	1.05	1.09	1.14	0.67	0.73	0.79
		total	1.05	1.09	1.13	0.63	0.68	0.73
	2	less than 16	1.40	3.23	7.44	0.17	0.35	0.68
		16 and 17	0.93	1.06	1.21	0.46	0.60	0.79
		18 -21	1.23	1.35	1.48	0.55	0.62	0.70
		total	1.20	1.29	1.39	0.52	0.59	0.66
	3 and more	less than 16	1.07	3.77	13.29	0.28	0.63	1.39
		16 and 17	1.42	1.67	1.97	0.54	0.72	0.97
		18 -21	1.54	1.74	1.97	0.55	0.64	0.74
		total	1.62	1.78	1.96	0.56	0.63	0.72

Two-vehicle Crash Involvement Ratio According to Number of Occupants

category		driver age	RCIRm					
			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*
number of passengers	1	less than 16	1.17	1.67	2.38	0.55	0.72	0.94
		16 and 17	1.01	1.06	1.11	0.71	0.79	0.87
		18 -21	1.02	1.05	1.08	0.92	0.96	1.01
		total	1.04	1.06	1.09	0.86	0.90	0.94
	2	less than 16	0.73	1.66	3.77	0.41	0.64	1.00
		16 and 17	0.92	1.02	1.12	0.74	0.88	1.03
		18 -21	1.00	1.07	1.14	0.78	0.84	0.90
		total	1.03	1.09	1.15	0.76	0.81	0.86
	3 and more	less than 16	0.91	3.04	10.11	0.57	1.02	1.85
		16 and 17	1.02	1.16	1.33	0.64	0.78	0.95
		18 -21	0.89	0.98	1.07	0.83	0.91	0.98
		total	1.02	1.10	1.18	0.79	0.85	0.92

Single-vehicle Crash Involvement Ratio Related to the Time of the Day

category		driver age	RCIRs								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
time of the day	peak hours (8 AM - 10 AM and 3PM - 7PM)	less than 16	0.50	0.61	0.75	1.07	1.91	3.41	0.15	0.25	0.43
		16 and 17	0.62	0.65	0.68	0.64	0.70	0.77	0.39	0.49	0.60
		18 -21	0.54	0.55	0.57	0.48	0.52	0.56	0.38	0.42	0.48
		total	0.57	0.59	0.60	0.56	0.60	0.64	0.39	0.43	0.48
	off-peak hours (5AM - 8AMand 10AM - 3PM)	less than 16	0.56	0.70	0.89	1.13	1.90	3.19	0.26	0.45	0.81
		16 and 17	0.76	0.80	0.83	0.60	0.67	0.74	0.53	0.67	0.84
		18 -21	0.77	0.79	0.81	0.67	0.73	0.79	0.46	0.52	0.58
		total	0.77	0.78	0.80	0.69	0.74	0.79	0.48	0.54	0.59
	7PM - 11PM	less than 16	0.91	1.23	1.65	1.23	2.34	4.45	0.29	0.67	1.54
		16 and 17	1.26	1.34	1.42	0.83	0.92	1.02	0.75	1.01	1.35
		18 -21	1.11	1.15	1.20	0.71	0.77	0.84	0.68	0.79	0.91
		total	1.18	1.22	1.26	0.80	0.85	0.91	0.71	0.81	0.92
	11 PM - 5 AM	less than 16	4.39	8.39	16.01	1.75	3.80	8.24	NA	NA	NA
		16 and 17	4.15	4.55	4.98	1.90	2.17	2.47	2.33	3.82	6.25
		18 -21	4.57	4.74	4.92	1.75	1.87	1.99	2.28	2.66	3.10
		total	4.42	4.57	4.73	1.80	1.90	2.01	2.29	2.64	3.05

Two-vehicle Crash Involvement Ratio Related to the Time of the Day

category		driver age	RCIRm								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
time of the day	peak hours (8 AM - 10 AM and 3PM - 7PM)	less than 16	0.96	1.10	1.26	1.10	1.84	3.08	0.44	0.59	0.79
		16 and 17	1.03	1.05	1.07	0.79	0.83	0.88	0.66	0.74	0.83
		18 -21	1.07	1.09	1.10	0.75	0.79	0.82	0.77	0.81	0.86
		total	1.07	1.08	1.09	0.80	0.82	0.85	0.75	0.78	0.82
	off-peak hours (5AM - 8AMand 10AM - 3PM)	less than 16	0.73	0.87	1.04	0.47	0.78	1.30	0.47	0.69	1.02
		16 and 17	0.99	1.02	1.05	0.79	0.84	0.90	0.75	0.86	0.98
		18 -21	1.05	1.06	1.08	0.81	0.85	0.89	0.79	0.84	0.89
		total	1.04	1.05	1.06	0.84	0.87	0.90	0.78	0.82	0.87
	7PM - 11PM	less than 16	0.47	0.62	0.82	0.79	1.44	2.63	0.44	0.82	1.53
		16 and 17	0.94	0.98	1.02	0.60	0.65	0.70	0.58	0.71	0.88
		18 -21	1.20	1.23	1.26	0.59	0.62	0.66	0.65	0.72	0.79
		total	1.13	1.16	1.18	0.62	0.65	0.68	0.65	0.70	0.76
	11 PM - 5 AM	less than 16	0.81	1.60	3.17	0.40	0.91	2.06	NA	NA	NA
		16 and 17	0.82	0.90	0.99	0.42	0.48	0.55	0.72	1.15	1.83
		18 -21	0.90	0.93	0.97	0.47	0.50	0.53	0.64	0.73	0.85
		total	0.87	0.90	0.93	0.46	0.48	0.51	0.65	0.74	0.85

Single-vehicle Crash Involvement Ratio related to the day of the week

category		driver age	RCIRs								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
day of the week	WEEKEND	less than 16	0.88	1.04	1.23	2.02	3.19	5.03	0.27	0.44	0.70
		16 and 17	1.13	1.17	1.20	1.32	1.43	1.54	0.51	0.63	0.77
		18 -21	1.28	1.30	1.33	1.29	1.35	1.42	0.53	0.59	0.65
		total	1.24	1.26	1.28	1.35	1.40	1.46	0.54	0.59	0.64
	WEEKDAY	less than 16	0.73	0.85	0.99	1.65	2.67	4.31	0.19	0.31	0.51
		16 and 17	0.78	0.80	0.83	0.98	1.07	1.16	0.51	0.61	0.73
		18 -21	0.77	0.79	0.80	0.87	0.92	0.97	0.51	0.56	0.61
		total	0.78	0.79	0.80	0.95	0.99	1.04	0.52	0.56	0.60

Two-vehicle Crash Involvement Ratio related to the day of the week

category		driver age	RCIRm								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
day of the week	WEEKEND	less than 16	0.92	1.05	1.21	1.04	1.63	2.53	0.51	0.70	0.96
		16 and 17	0.99	1.01	1.04	1.00	1.05	1.12	0.69	0.78	0.88
		18 -21	1.02	1.03	1.04	0.87	0.91	0.94	0.72	0.76	0.80
		total	1.01	1.03	1.04	0.94	0.96	0.99	0.71	0.75	0.79
	WEEKDAY	less than 16	0.89	1.01	1.13	1.02	1.61	2.54	0.46	0.62	0.83
		16 and 17	1.01	1.03	1.04	1.02	1.08	1.14	0.67	0.75	0.83
		18 -21	1.05	1.06	1.08	0.91	0.94	0.97	0.77	0.80	0.84
		total	1.04	1.05	1.06	0.97	1.00	1.03	0.74	0.78	0.81

Single-vehicle Crash Involvement Ratio with Respect to the use of Safety Restraints

category		driver age	RCIRs								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
safety restraint usage(shoulder belt/lapbelt or both)	no safety restraint used	less than 16	0.93	1.43	2.20	2.99	6.99	16.35	1.68	7.34	32.13
		16 and 17	5.16	6.05	7.10	7.87	9.78	12.15	4.14	6.42	9.93
		18 -21	6.14	6.64	7.18	6.74	7.60	8.57	3.56	4.31	5.22
		total	5.87	6.29	6.74	7.43	8.24	9.14	3.90	4.63	5.50
	some safety restraint used	less than 16	1.09	1.49	2.04	1.24	1.87	2.82	0.17	0.25	0.38
		16 and 17	0.96	1.00	1.05	0.91	0.97	1.04	0.46	0.54	0.63
		18 -21	0.86	0.88	0.90	0.82	0.86	0.90	0.50	0.54	0.58
		total	0.88	0.89	0.91	0.88	0.91	0.95	0.49	0.52	0.56

Two-vehicle Crash Involvement Ratio with Respect to the use of Safety Restraints

category		driver age	RCIRm								
			solo *(driver alone in the vehicle)*			peer *(passenger age between 12 and 24)*			adult/child *(atleast one passenger not between age 12 and 24)*		
			LL	*EST*	*UL*	*LL*	*EST*	*UL*	*LL*	*EST*	*UL*
safety restraint usage(shoulder belt/lapbelt or both)	no safety restraint used	less than 16	1.36	1.95	2.80	1.00	2.35	5.55	0.70	3.05	13.24
		16 and 17	1.53	1.78	2.08	1.30	1.63	2.04	1.10	1.69	2.58
		18 -21	1.51	1.63	1.76	1.17	1.33	1.50	0.99	1.19	1.43
		total	1.58	1.69	1.80	1.29	1.43	1.60	1.08	1.27	1.49
	some safety restraint used	less than 16	1.03	1.36	1.78	0.92	1.34	1.95	0.49	0.62	0.77
		16 and 17	1.08	1.11	1.14	0.96	1.00	1.05	0.65	0.71	0.78
		18 -21	1.08	1.10	1.12	0.86	0.88	0.91	0.75	0.78	0.81
		total	1.07	1.09	1.10	0.92	0.94	0.96	0.73	0.75	0.78

VITA

Cherian Cherian-Korah was born in May, 1981, in the evergreen city of India, Trivandrum. He did his schooling from Sarvodaya Vidyalalaya in Trivandrum and went on to obtain the degree of Bachelor of Technology in Civil Engineering from Kerala University, India. He worked for two years after the graduation and then decided to continue his studies. Thus he joined the master's program to study transportation engineering in the Department of Civil and Environmental Engineering at Louisiana State University, Baton Rouge, Louisiana, in August, 2005, where he enjoyed his return to the student life and saw the Tigers crowned National Champions in 2007. He is expected to fulfill the requirements for a degree of Master of Science in Civil Engineering in August 2008.